

Chapter 17

# **Formation Pressures and Gas-Flow Rates from Well Tests, Southwestern Wyoming Province, Wyoming, Colorado, and Utah**



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**Volume Title Page**

By Philip H. Nelson and Joyce E. Kibler

Chapter 17 of

## **Petroleum Systems and Geologic Assessment of Oil and Gas in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah**

By USGS Southwestern Wyoming Province Assessment Team

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# Formation Pressures and Gas-Flow Rates from Well Tests, Southwestern Wyoming Province, Wyoming, Colorado, and Utah

By Philip H. Nelson and Joyce E. Kibler

## Abstract

Pressure and gas-flow-rate data provide valuable information for the assessment of oil and gas resources. Pressures from drill-stem tests and gas-flow rates from initial potential and production tests in wells in the Southwestern Wyoming Province have been extracted from a commercial database and separated into seven stratigraphic groups. Pressure and gas-flow rates are presented in maps and as plots of pressure or rate as a function of depth. In addition, plots of the completion date for the wells from which data were obtained also are provided. Because the results from the maps and plots were incorporated into assessments of individual petroleum systems, the data are presented here with only minimal interpretive comments.

## Introduction

Formation pressure and gas-flow rates are two data types that are commonly recorded while drilling exploration and production wells. Recovery and presentation of these data are valuable for assessing the hydrocarbon potential of a petroleum system.

Drill-stem tests (DSTs) measure the downhole pressure of fluid within the well bore rather than the formation pressure itself. Shut-in pressure readings from DSTs must be

extrapolated and corrected carefully in order to obtain the best estimate of true formation pressure (Holm, 1998). Such analyses were not carried out in our study, which simply presents uncorrected pressure data from a large number of DSTs within the basins of the Southwestern Wyoming Province (fig. 1). Editing procedures are described herein.

Gas-flow rates are determined by well tests that are classed as either initial potential or production tests by IHS Energy Group (2001). The gas volumes recovered during a test are reported as a daily rate in thousands of cubic feet of gas per day (MCFD) at standard temperature and pressure. The flow rates are indicative of the potential productivity of a given perforated interval within a formation but may not be directly proportional to the ultimate gas recovery in a well.

## Stratigraphic Groups

The source of drill-stem test pressure data and gas-flow rate data used in our study was the database supplied by IHS Energy Group (2001), which included all wells within the boundary of the Southwestern Wyoming Province. Data were sorted by formation code into stratigraphic groups that were expected to correspond to petroleum systems. As the project evolved, nine total petroleum systems were defined. The correspondence between the seven stratigraphic groups used in this paper and the nine total petroleum systems discussed elsewhere in this publication is shown in table 1. Five of the

**Table 1.** Correspondence between stratigraphic groups and total petroleum systems (TPS).

Stratigraphic groups	Total petroleum systems
Phosphoria-sourced units	Phosphoria TPS
Frontier, Mowry, and Dakota Formations, and age-equivalent formations	Mowry Composite TPS
Niobrara Formation	Niobrara TPS
Baxter and Hilliard Shales, and age-equivalent shales	Hilliard–Baxter–Mancos TPS
Mesaverde Group	Mesaverde–Lance–Fort Union Composite TPS
Lewis Shale	Mesaverde TPS
Lance, Fort Union, and Wasatch Formations and related formations	Lewis TPS
	Wasatch–Green River Composite TPS
	Lance–Fort Union Composite TPS
	Mesaverde–Lance–Fort Union Composite TPS



**Figure 1.** Geological structures within the Southwestern Wyoming Province, Wyoming, Colorado, and Utah.

stratigraphic groups correspond directly to a single total petroleum system, whereas the remaining two include more than one total petroleum system.

The combination of formations contributing most of the pressure and gas-flow-rate data within each stratigraphic group are as follows:

The Phosphoria-sourced units include the Mississippian Madison Limestone, the Pennsylvanian Tensleep and Weber Sandstones, the Permian Phosphoria Formation, the Shinarump Member of the Triassic Chinle Formation, the Triassic/Jurassic Nugget Sandstone, and the Jurassic Morrison and Curtis Formations and Entrada Sandstone.

The stratigraphic group Frontier, Mowry, and Dakota Formations and age-equivalent formations, all of Cretaceous age, include the Bear River, Cloverly, and Frontier Formations, the Dakota and Muddy Sandstones, and the Mowry Shale.

The Baxter and Hilliard Shales and age-equivalent shales include the Baxter, Hilliard, Mancos, and Steele Shales, the Blair Formation, the Morapos Sandstone Member of the Mancos Shale, the Deep Creek Sandstone Member of the Haystack Mountains Formation, and the Shannon Sandstone Member of the Steele Shale. All are Late Cretaceous in age.

The Cretaceous Mesaverde Group includes tests from the Almond Formation, Ericson Sandstone, Rock Springs Formation, and undifferentiated Mesaverde strata.

The Lance, Fort Union, and Wasatch Formations include the Fox Hills Sandstone and Lance Formation of Late Cretaceous age and the Fort Union, Almy, and Wasatch Formations of Tertiary age. In addition, tests from the Wilkins Peak Member of the Tertiary Green River Formation and from undifferentiated Tertiary units are included in this stratigraphic group.

Two maps and four plots are presented and also given in table 2 for each of the five groups previously listed, as well as for the Niobrara Formation and the Lewis Shale.

Maps and plots (figs. 2–8) of DST pressure data for each stratigraphic group are at the back of the report.

- (A) Map of maximum pressure gradient (one point per well)

- (B) Plot of completion date and depth to top of test interval (one or more points per well)
- (C) Plot of pressure and depth to top of test interval (one or more points per well)
- Maps and plots of gas-flow rates for each stratigraphic group:
- (D) Map of maximum gas-flow rate (one point per well)
- (E) Plot of completion date and depth to top of test interval (one point per well)
- (F) Plot of maximum gas-flow rate and depth to top of test interval (one point per well)

Editing Procedures

The DST pressure and gas-flow rate data were spot checked against card and microfiche files to confirm that data were extracted and sorted correctly.

The DST pressure data were edited to eliminate excessively low or high reported pressures. Pressures measured by DSTs can be less than the actual formation pressure due to poor contact with the borehole wall or to insufficient pressure buildup in a low-permeability formation. The larger of the final shut-in and initial shut-in pressures was divided by the depth of the test interval to obtain the pressure gradient from each DST. If that value was less than 0.3 pound per square inch per foot (psi/ft), the test was dropped from the data set. On the other hand, excessively high pressures were few in number. The pressure-depth plots were inspected and a few data points with anomalously high pressures were removed because they were judged to be either faulty tests or erroneously reported data.

For example, 2,482 DST pressure values were recovered from the stratigraphic group “Frontier, Mowry, and Dakota

Table 2. Figure numbers of maps and plots presented in this chapter.

Stratigraphic group	Pressure from drill-stem tests			Gas-flow rate		
	Map	Completion date and depth	Pressure and depth	Map	Completion date and depth	Flow rate and depth
Phosphoria-sourced units	2A	2B	2C	2D	2E	2F
Frontier, Mowry, and Dakota Formations and age-equivalent formations	3A	3B	3C	3D	3E	3F
Niobrara Formation	4A	4B	4C	4D	4E	4F
Baxter and Hilliard Shales and age-equivalent shales	5A	5B	5C	5D	5E	5F
Mesaverde Group	6A	6B	6C	6D	6E	6F
Lewis Shale	7A	7B	7C	7D	7E	7F
Lance, Fort Union and Wasatch Formations and related formations	8A	8B	8C	8D	8E	8F

Formations and age-equivalent formations.” Only four DST pressure values produced pressure gradients in excess of 1.0 psi/ft and were removed from the data set, leaving 2,478 values. Of these, 1,377 pressure values from 816 wells yielded pressure gradients greater than 0.3 psi/ft and were retained. Many wells yielded more than one valid DST pressure; all retained pressures are plotted as a function of completion date (fig. 3B) and of depth (fig. 3C). However, because only one well symbol can be shown on a map, the maximum pressure gradient was determined and mapped for each of the 816 wells. Consequently, the map (fig. 3A) contains 816 data points, whereas the plot of completion date and depth (fig. 3B) and the plot of pressure and depth (fig. 3C) contain 1,377 data points.

The gas-flow-rate data were separated into stratigraphic groups and the maximum rate determined. Flow rates less than maximum were not retained because in most wells only one interval within a stratigraphic group was flow tested and the maximum rate was obtained after a series of stimulation attempts and tests. Hence, the maps of maximum gas-flow rates, the plots of completion date and depth, and the plots of maximum gas-flow rate and depth all have the same number of data points. For example, the stratigraphic group “Frontier, Mowry, and Dakota Formations and age-equivalent formations” has 3,135 data points in figures 3D, 3E, and 3F.

All depths are reported as measured depth, which is the distance from a reference point (usually the Kelly bushing) measured down the length of the well to the depth of the test interval.

## Description of Maps and Plots

Locations of wells, pressure ranges, and gas-flow rates can be related to geological features by comparing the pressure and gas-flow maps with figure 1. The maps can also be compared with relevant maps in other chapters in this publication. For example, figures 3A and 3C can be compared with figure 4 of Kirschbaum and Roberts (Chapter 5, this CD-ROM), which shows structural contours and vitrinite reflectance for the top of the Frontier Formation.

Some features that can be observed on the data plots:

- The time axis on the plots of gas-rate completion date (figs. 2E, 3E, 4E, 5E, 6E, 7E, and 8E) varies among stratigraphic units, reflecting time periods for the onset of drilling and production testing. Before 1940, most wells were drilled to depths less than 4,000 ft.
- After 1990, few DSTs were obtained (figs. 2B, 3B, 4B, 5B, 6B, 7B, and 8B). The earliest use of DSTs is 1944 (fig. 3B).
- The data for plots from the Frontier-Mowry-Dakota units (figs. 3B, 3C, 3E, 3F) are so numerous that plus symbols (+) were used for the Frontier Formation to

avoid obscuring data from other formations in the group.

- The onset of deep drilling in the mid-1970s in southwestern Wyoming is particularly apparent in the Frontier-Mowry-Dakota units (figs. 3B and 3E), the Mesaverde Group (fig. 6E), and the Lewis Shale (figs. 7B and 7E).
- Pressure increases with depth (figs. 2C, 3C, 4C, 5C, 6C, 7C, and 8C), with most points lying between 0.3 psi/ft (the minimum retained value) and 0.433 psi/ft (the freshwater hydrostatic gradient). A large number of points plot between 0.433 and 0.5 psi/ft, representing normally pressured to slightly overpressured values. Pressure gradients exceeding 0.5 psi/ft, which represent significant overpressure, tend to be more prevalent at depths greater than (1) 13,000 ft in the Phosporia-sourced units; (2) 6,000 ft in the Frontier Formation (fig. 3C) and 7,000 ft in other formations of the Frontier-Mowry-Dakota group (fig. 3C); (3) 9,000 ft in the Baxter and Hilliard Shales, and age-equivalent shales (fig. 5C); (4) 7,000 ft in the Mesaverde Group (fig. 6C); (5) 7,000 ft in the Lewis Shale (fig. 7C); and (6) 9,000 ft in the Lance-Fort Union-Wasatch group of formations (fig. 8C). Pressure data for the Niobrara Formation (fig. 4C) are not adequate to determine whether or not higher pressure gradients exist at depth.

## Summary

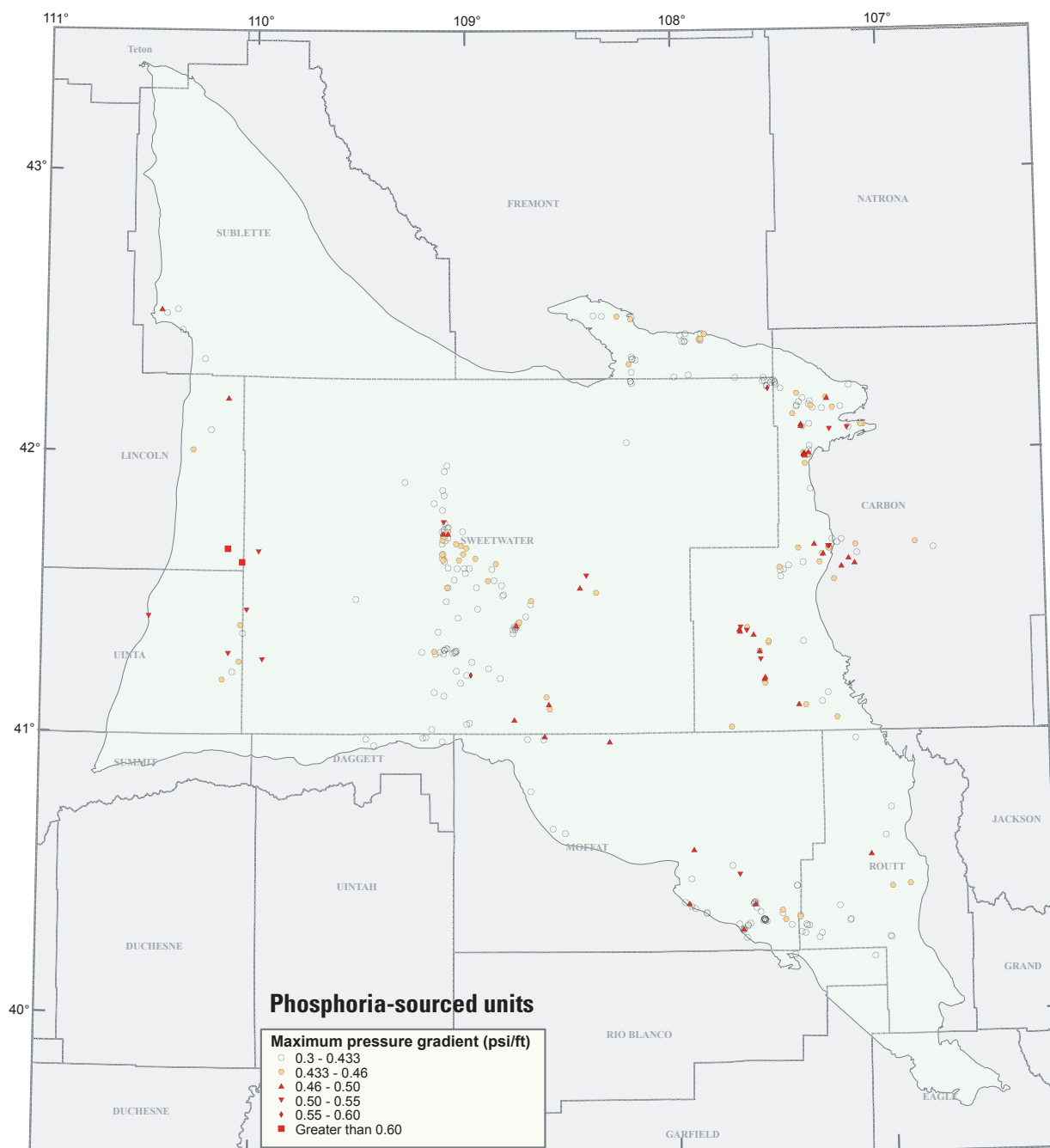
Pressure and gas-flow rate data from the Southwestern Wyoming Province have been extracted from a commercial database, organized into seven stratigraphic groups, edited, and made available to geologists assessing total petroleum systems in the province. Pressure values corresponding to gradients less than 0.433 psi/ft can represent either underpressured formations or readings that failed to reach true formation pressure; the existence of underpressured formations is best inferred from geographic and stratigraphic consistency. Pressure values corresponding to gradients greater than 0.5 psi/ft are likely to be valid and represent overpressured formations, as shown in maps and pressure-depth plots. Overpressuring conditions exist in six of the seven stratigraphic groups and are more prevalent at deeper than at shallower depths. The combination of maps of maximum pressure gradient and maximum gas-flow rate, plots of completion date and depth, and plots of pressure gradient and gas-flow rate and depth provide a broad perspective on development drilling in the province as a function of time, stratigraphic unit, and geographic location.



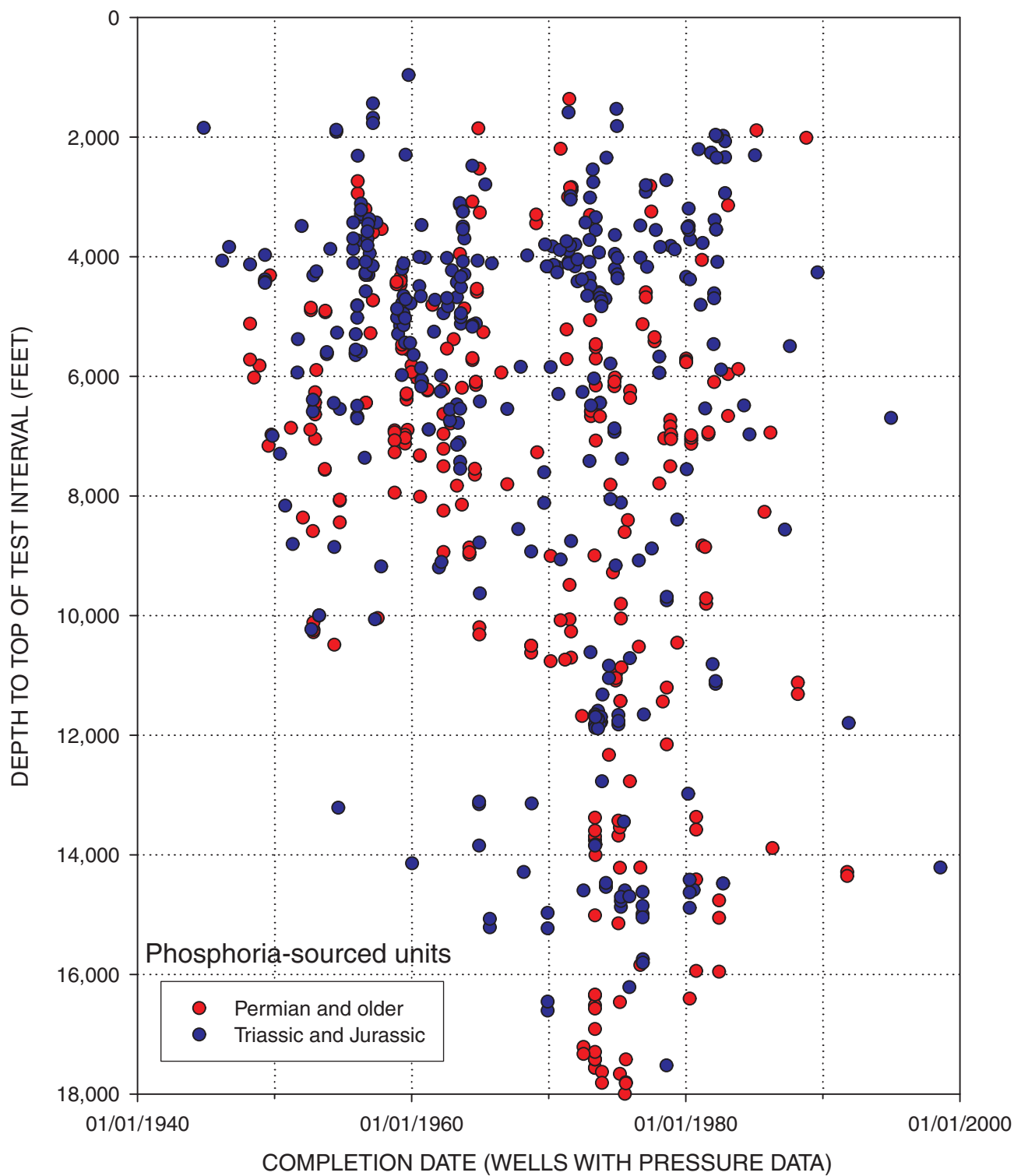
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Holm, G.M., 1998, Distribution and origin of overpressure in the Central Graben of the North Sea, in Law, B.E., Ulmishek, G.F., and Slavin, V.I., eds., *Abnormal pressures in hydrocarbon environments*: American Association of Petroleum Geologists Memoir 70, p. 123–144.

IHS Energy Group, 2001, [includes data current as of December, 2000] PI/Dwights Plus U.S. Production and Well Data: Englewood, Colo., database available from IHS Energy Group, 15 Inverness Way East, D205, Englewood, CO 80112, U.S.A.

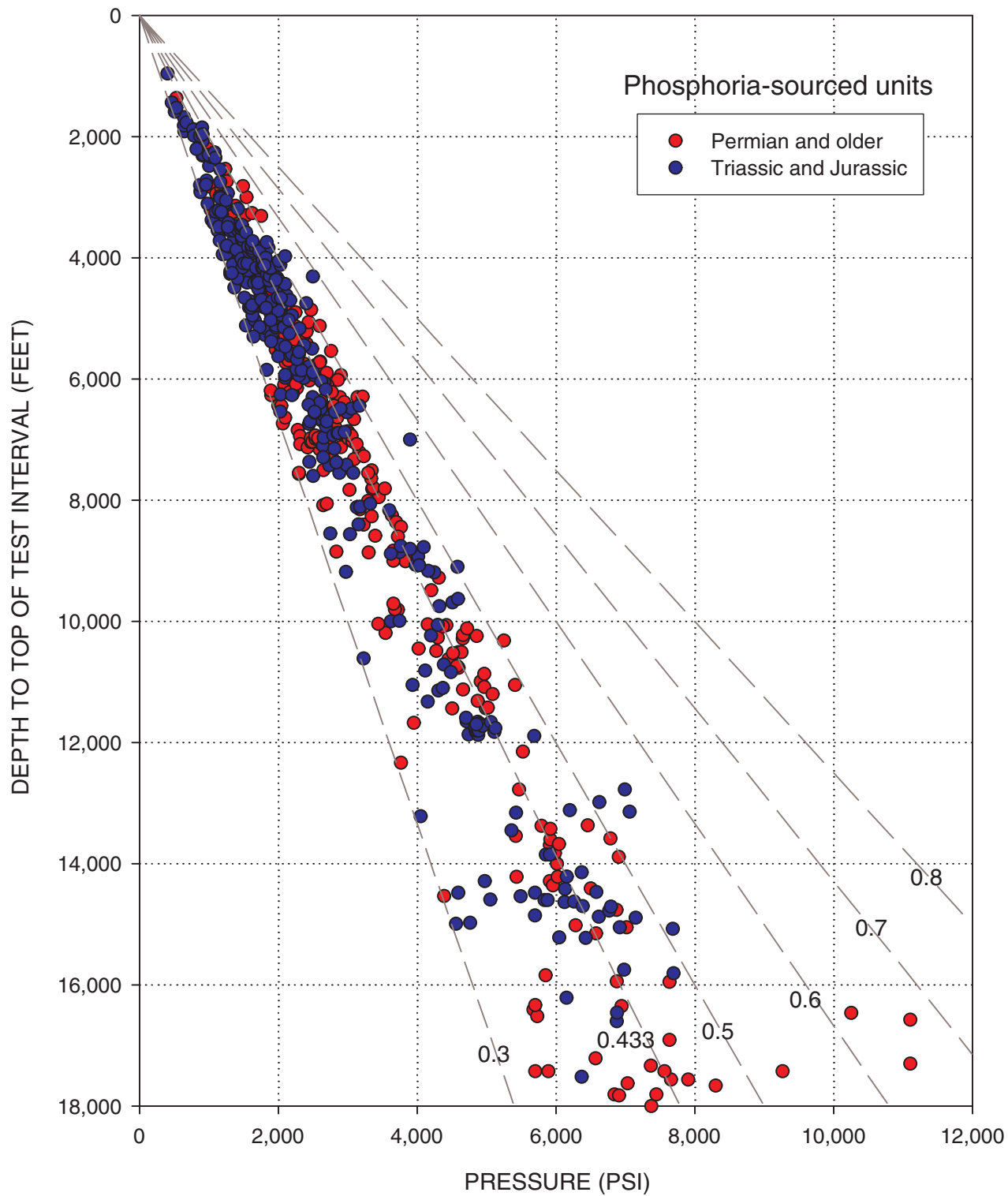


**Figure 2A.** Maximum pressure gradient in pounds per square inch per foot (psi/ft) determined from drill-stem tests in Jurassic and older Phosphoria-sourced units, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.

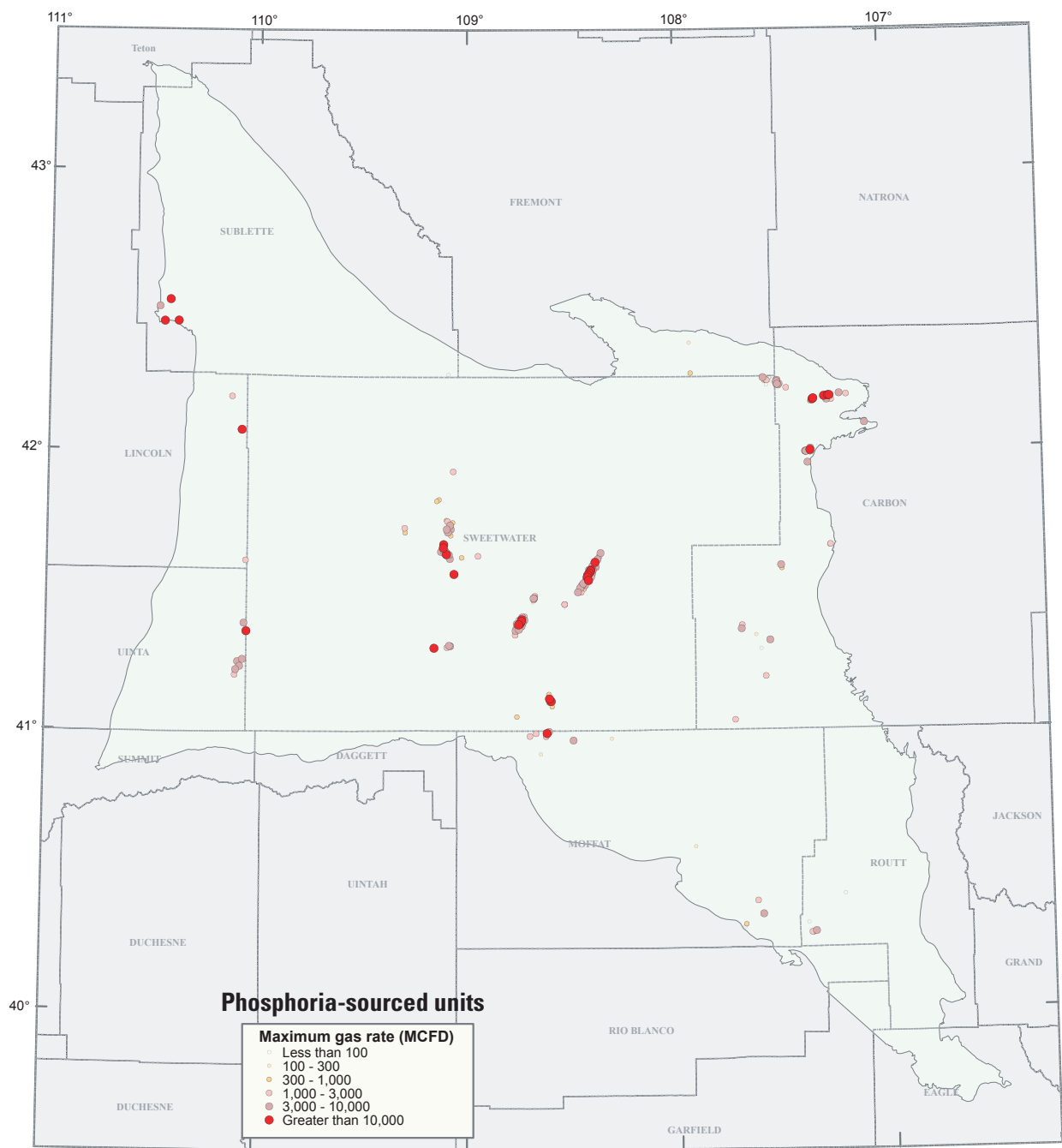


**Figure 2B.** Completion date and depth to tested intervals in wells with pressure data from Jurassic and older Phosphoria-sourced units in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 2A.

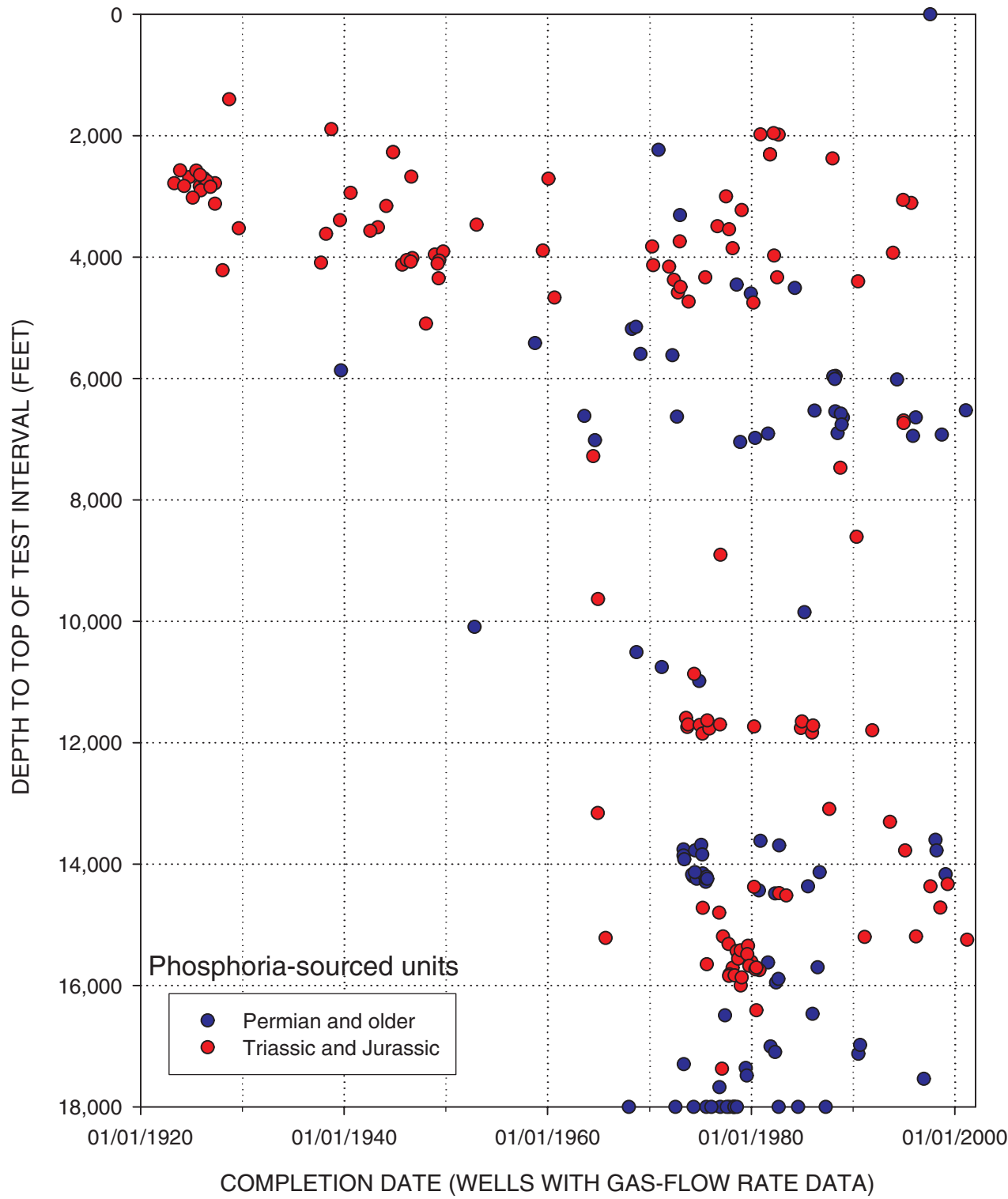




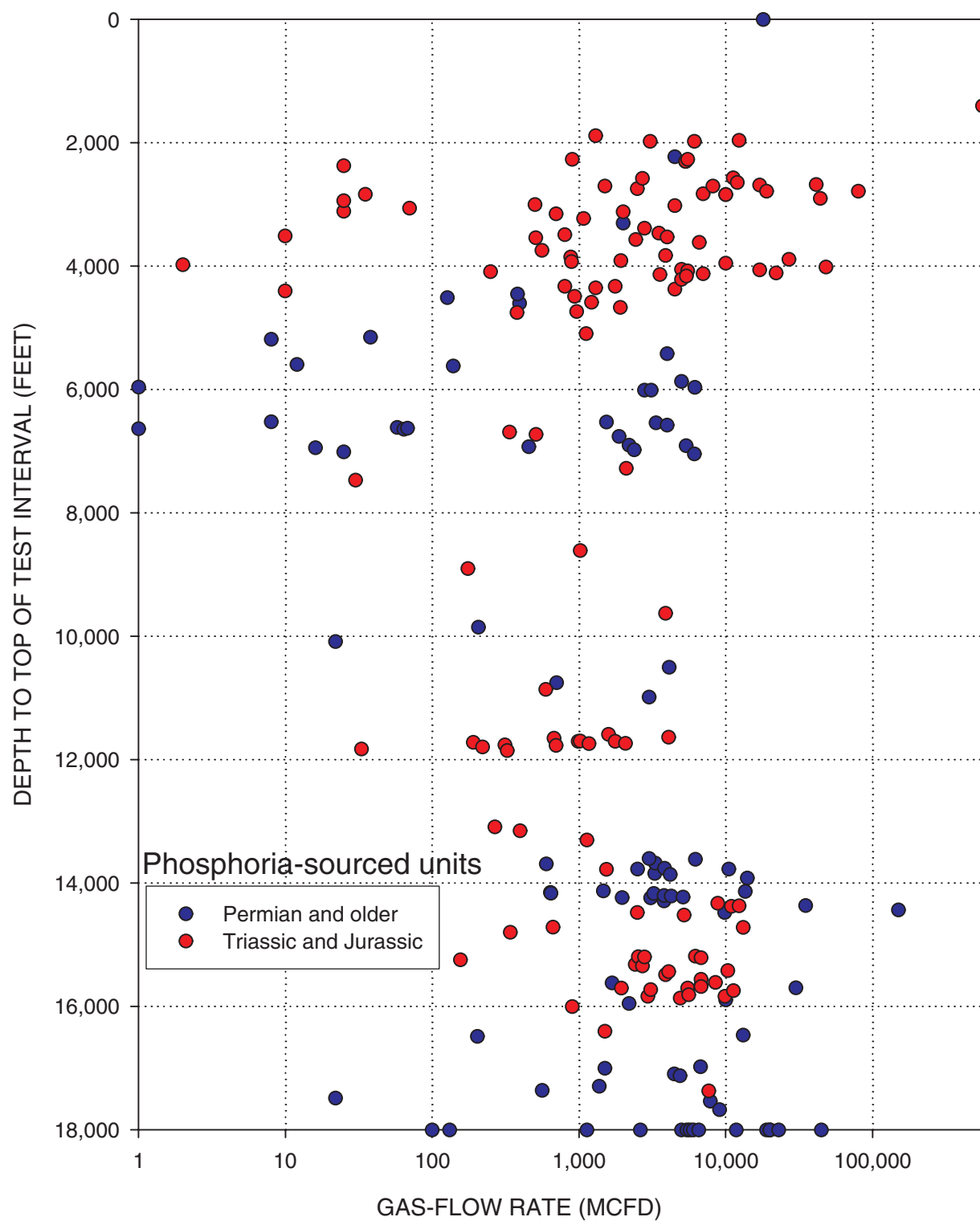
**Figure 2C.** Pressure data from wells with drill-stem tests in Jurassic and older Phosphoria-sourced units in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Lines of constant pressure gradient give ratio of pressure to depth in pounds per square inch per foot (psi/ft). Well locations are shown in figure 2A.



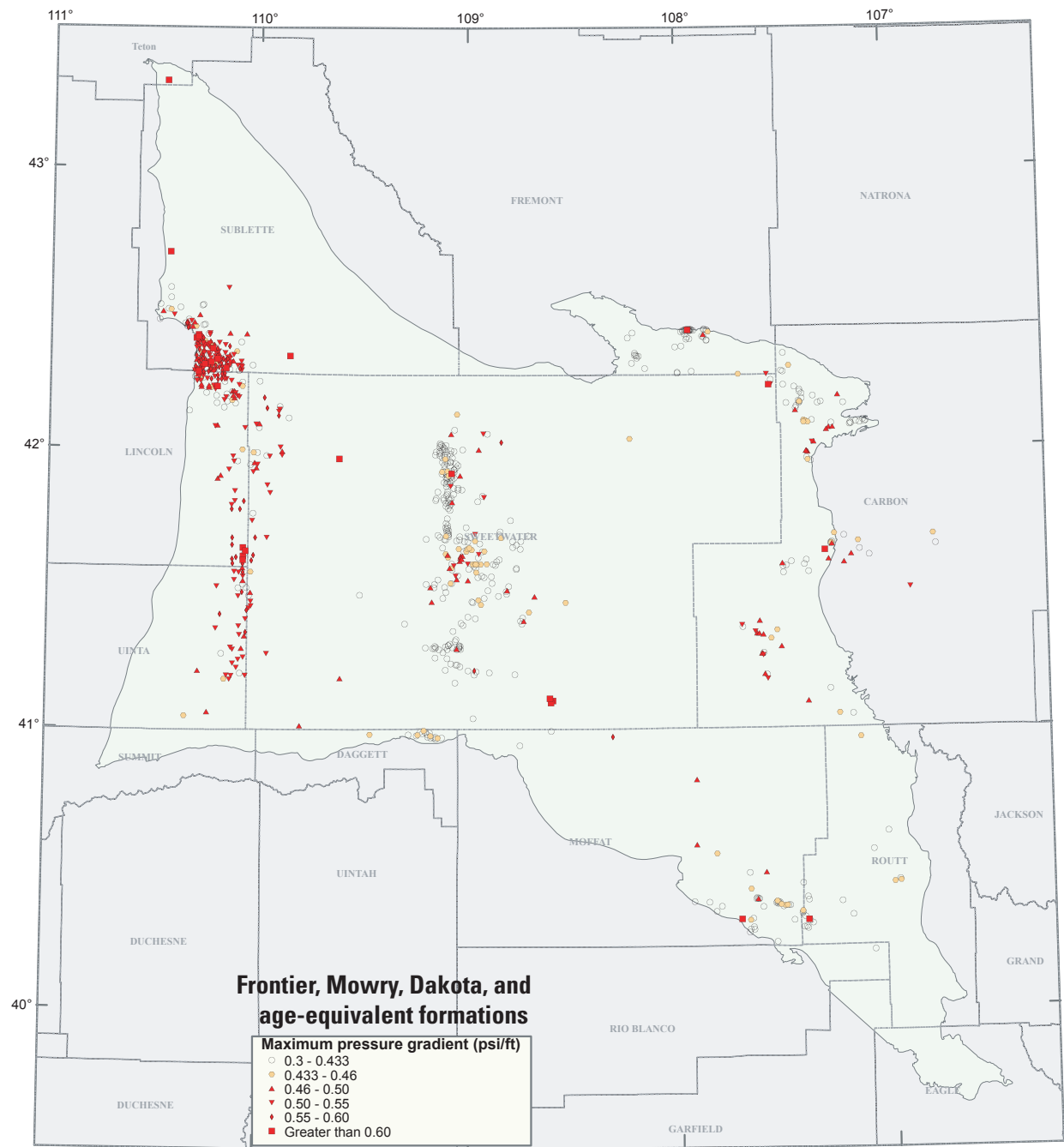
**Figure 2D.** Maximum gas-flow rates in thousands of cubic feet per day (MCFD) from well tests in Jurassic and older Phosphoria-sourced units, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.



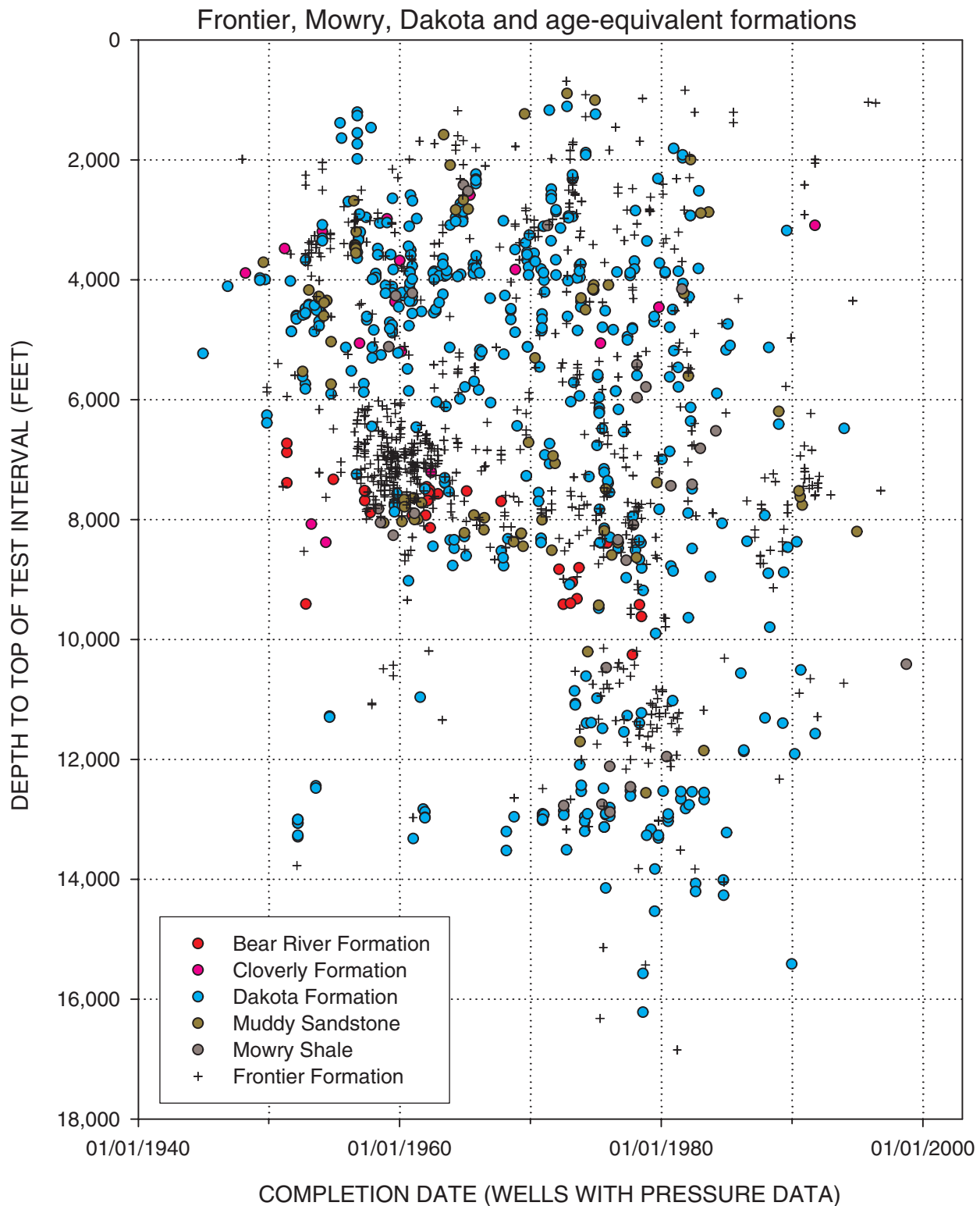
**Figure 2E.** Completion date and depth to tested intervals in wells with gas-flow rate data (initial potential or production tests) from Jurassic and older Phosphoria-sourced units in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 2D.



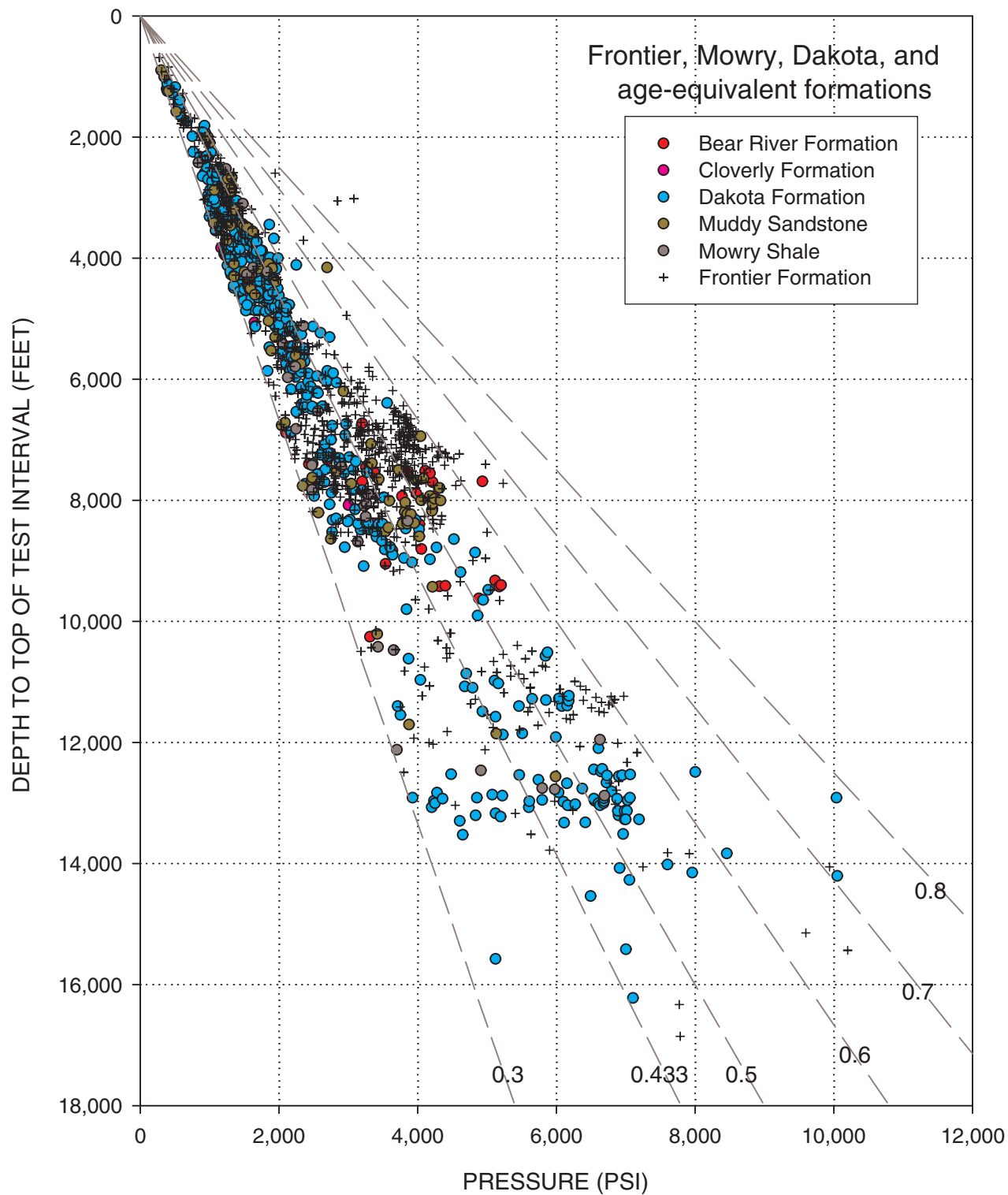
**Figure 2F.** Maximum gas-flow rate (initial potential or production tests) in thousands of cubic feet per day (MCFD) and depth to top of tested interval from Jurassic and older Phosphoria-sourced units in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 2D.



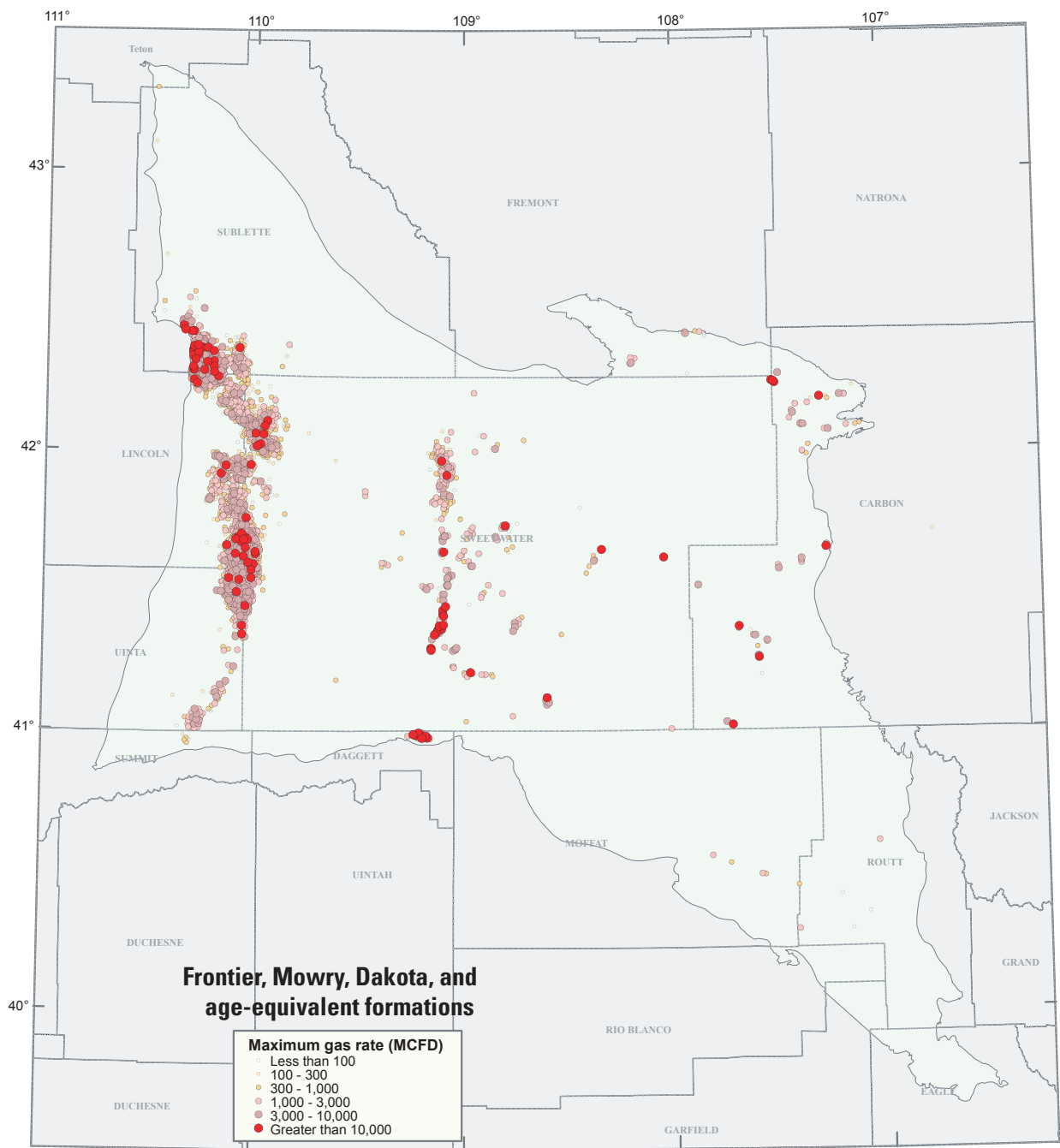
**Figure 3A.** Maximum pressure gradient in pounds per square inch per foot (psi/ft) from drill-stem tests in Cretaceous Frontier, Mowry, and Dakota Formations and age-equivalent formations, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.



**Figure 3B.** Completion date and depth to tested intervals in wells with pressure data from Cretaceous Frontier, Mowry, and Dakota Formations and age-equivalent formations in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 3A.

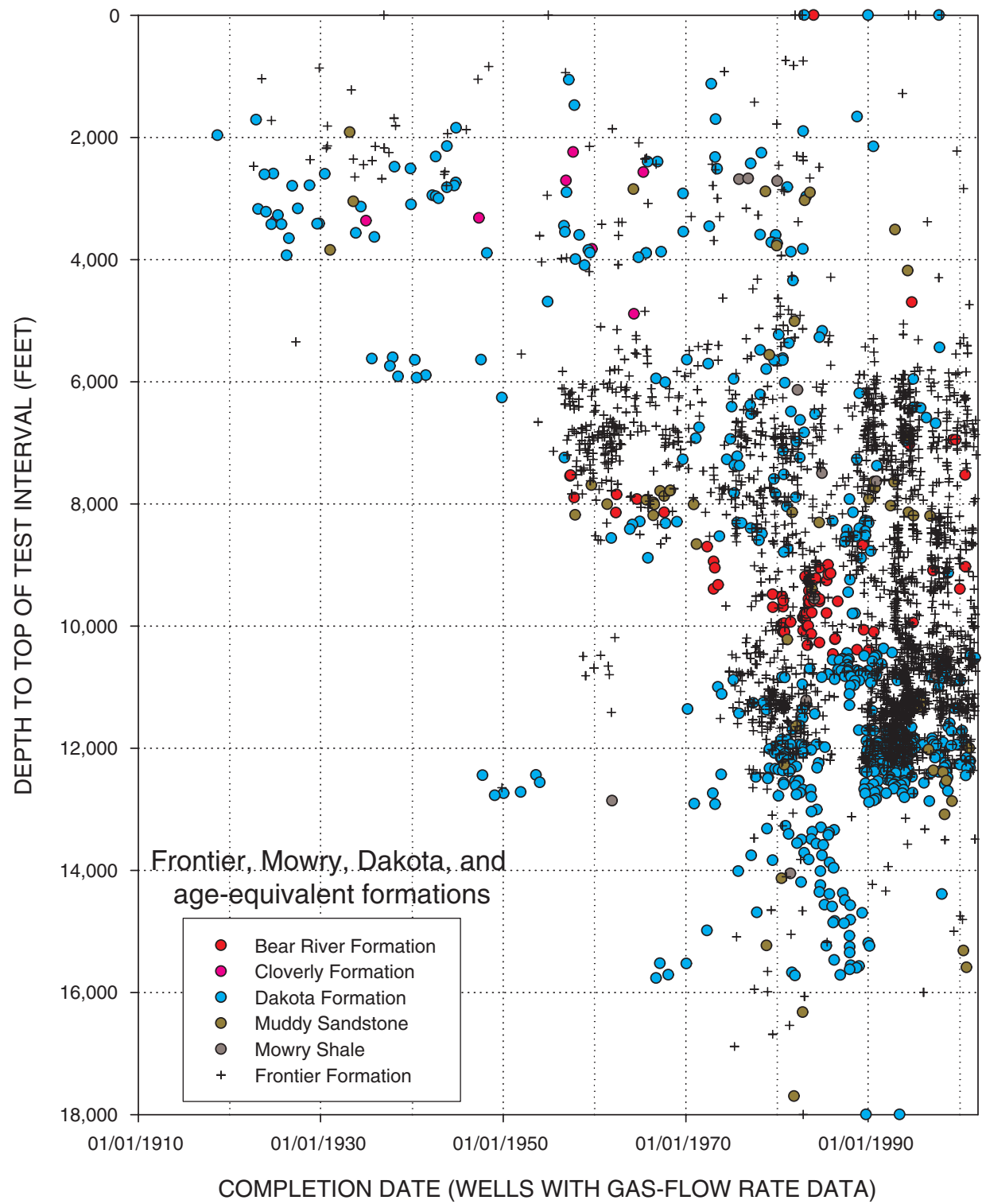


**Figure 3C.** Pressure data from wells with drill-stem tests in Cretaceous Frontier, Mowry, and Dakota Formations and age-equivalent formations in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Lines of constant pressure gradient give ratio of pressure to depth in pounds per square inch per foot (psi/ft). Well locations are shown in figure 3A.

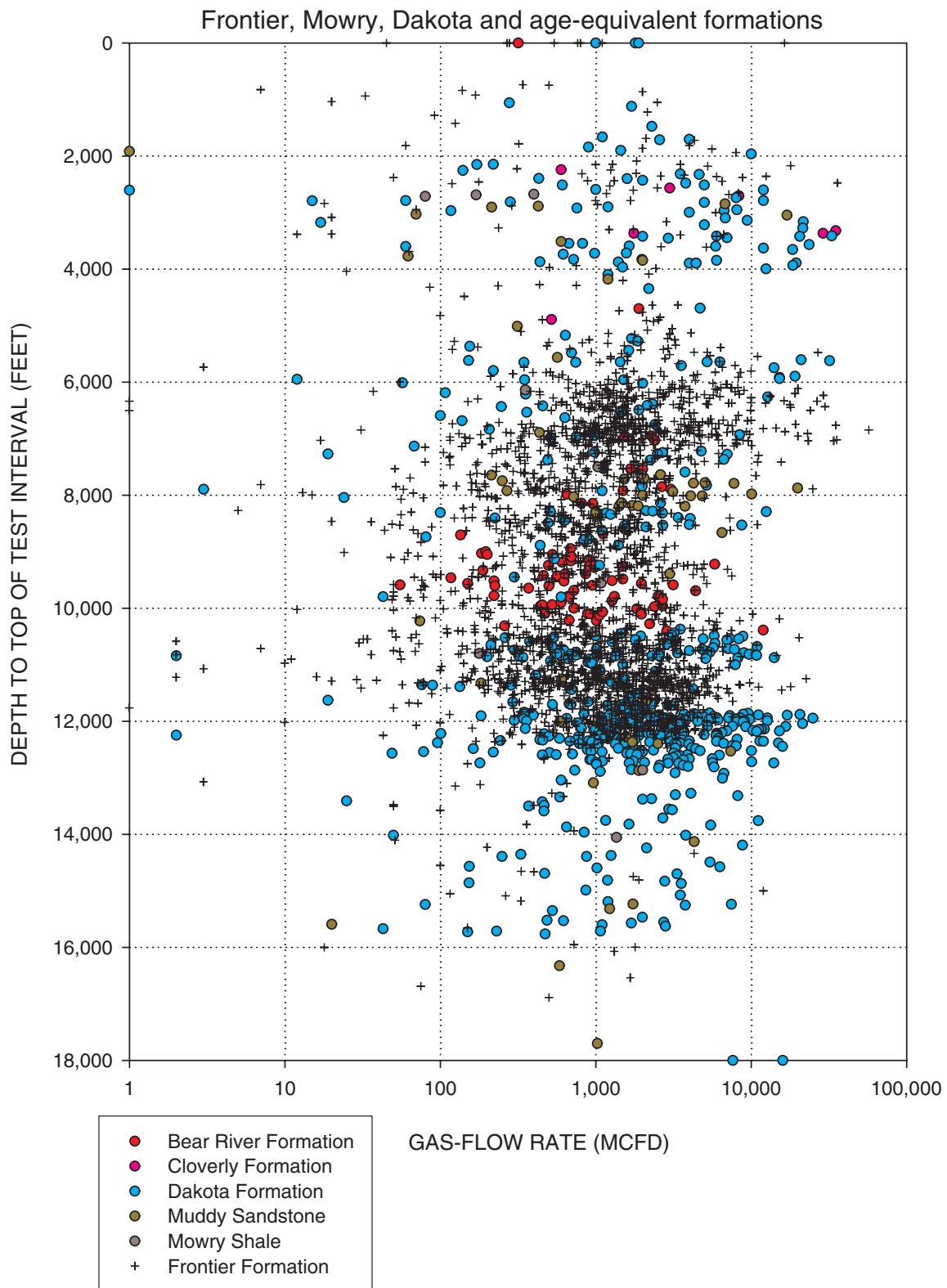


**Figure 3D.** Maximum gas-flow rates in thousands of cubic feet per day (MCFD) from well tests in Cretaceous Frontier, Mowry, and Dakota Formations and age-equivalent formations, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.

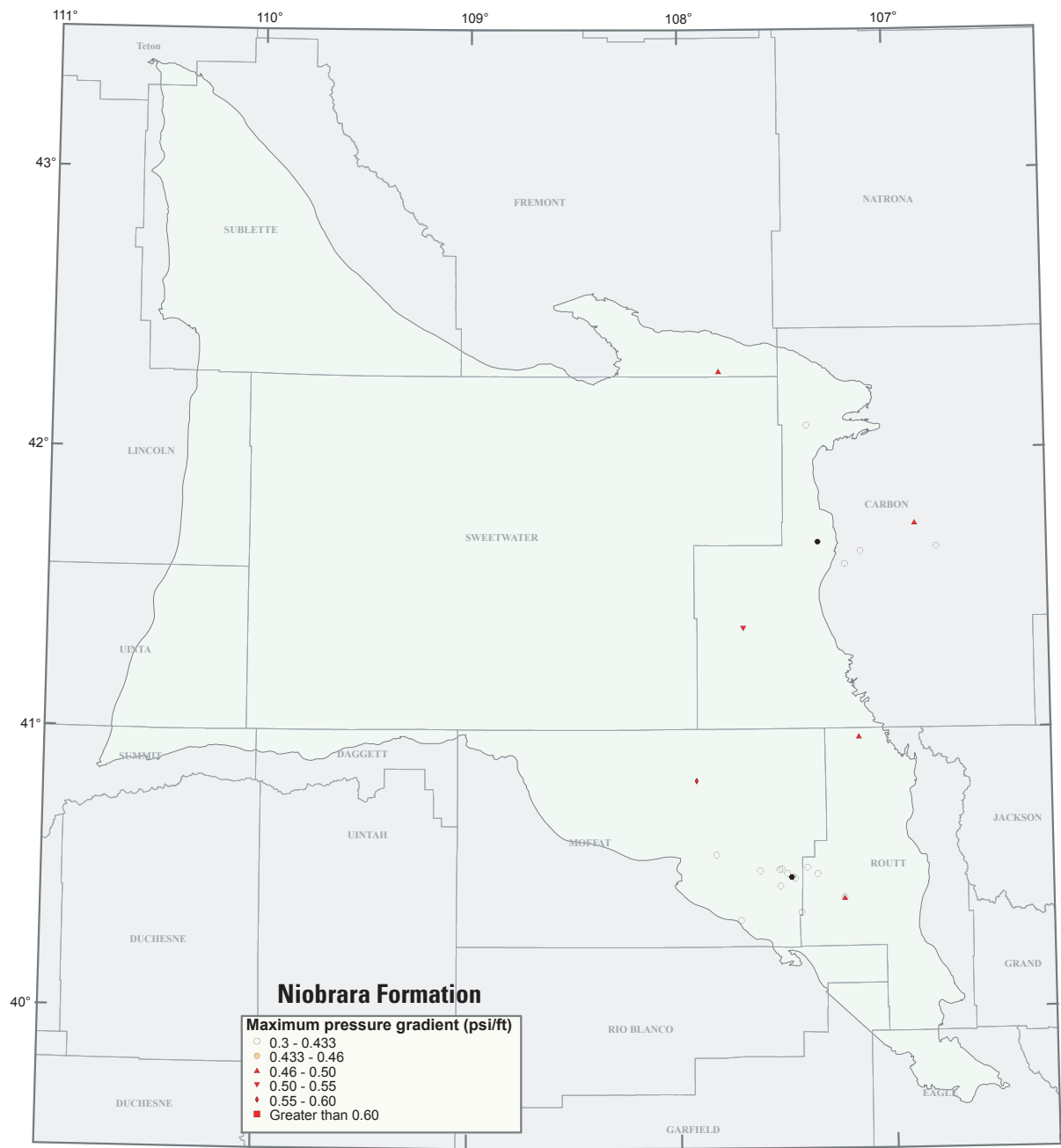




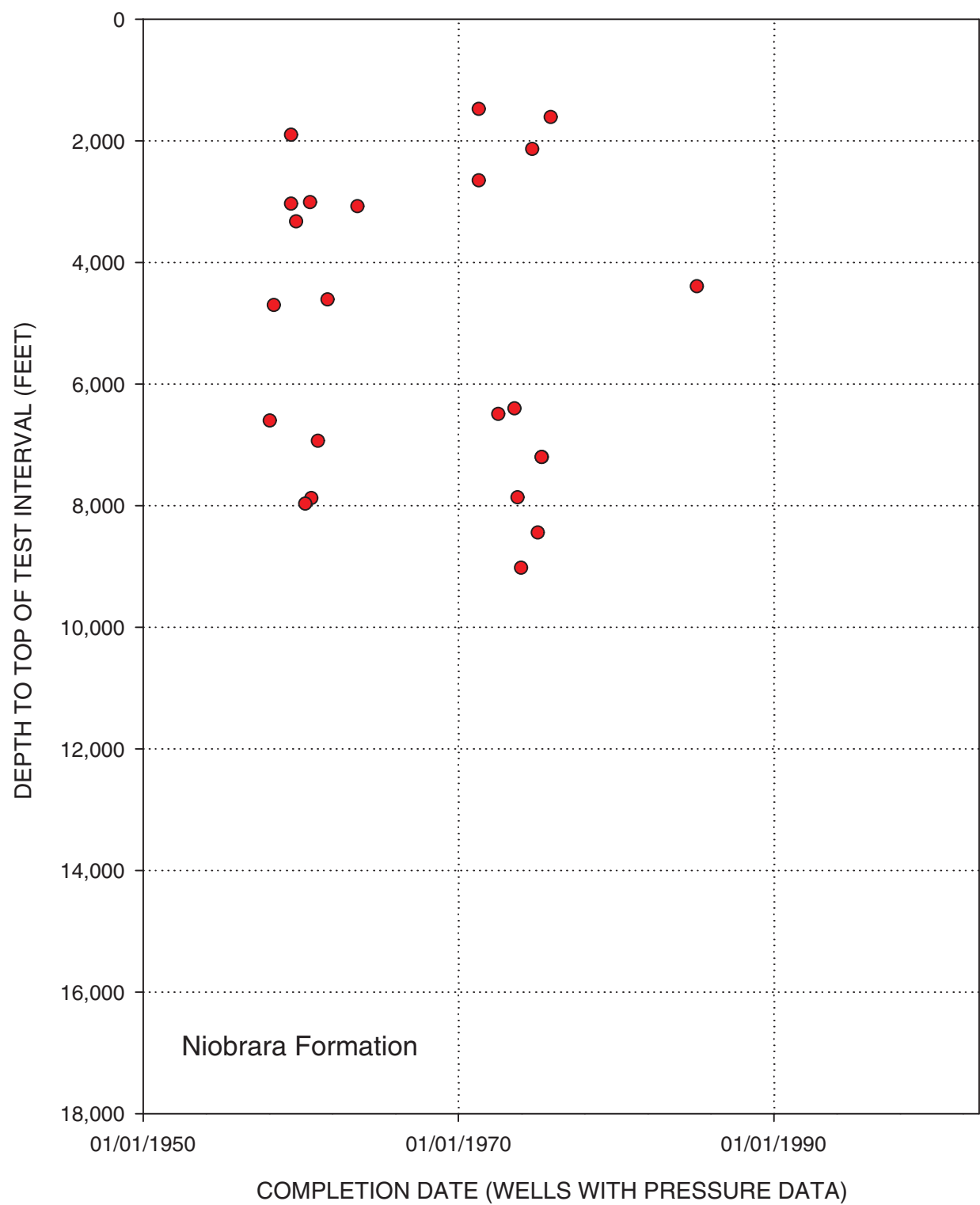
**Figure 3E.** Completion date and depth to tested intervals in wells with gas-flow rate data (initial potential or production tests) from Cretaceous Frontier, Mowry, and Dakota Formations and age-equivalent formations in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 3D.



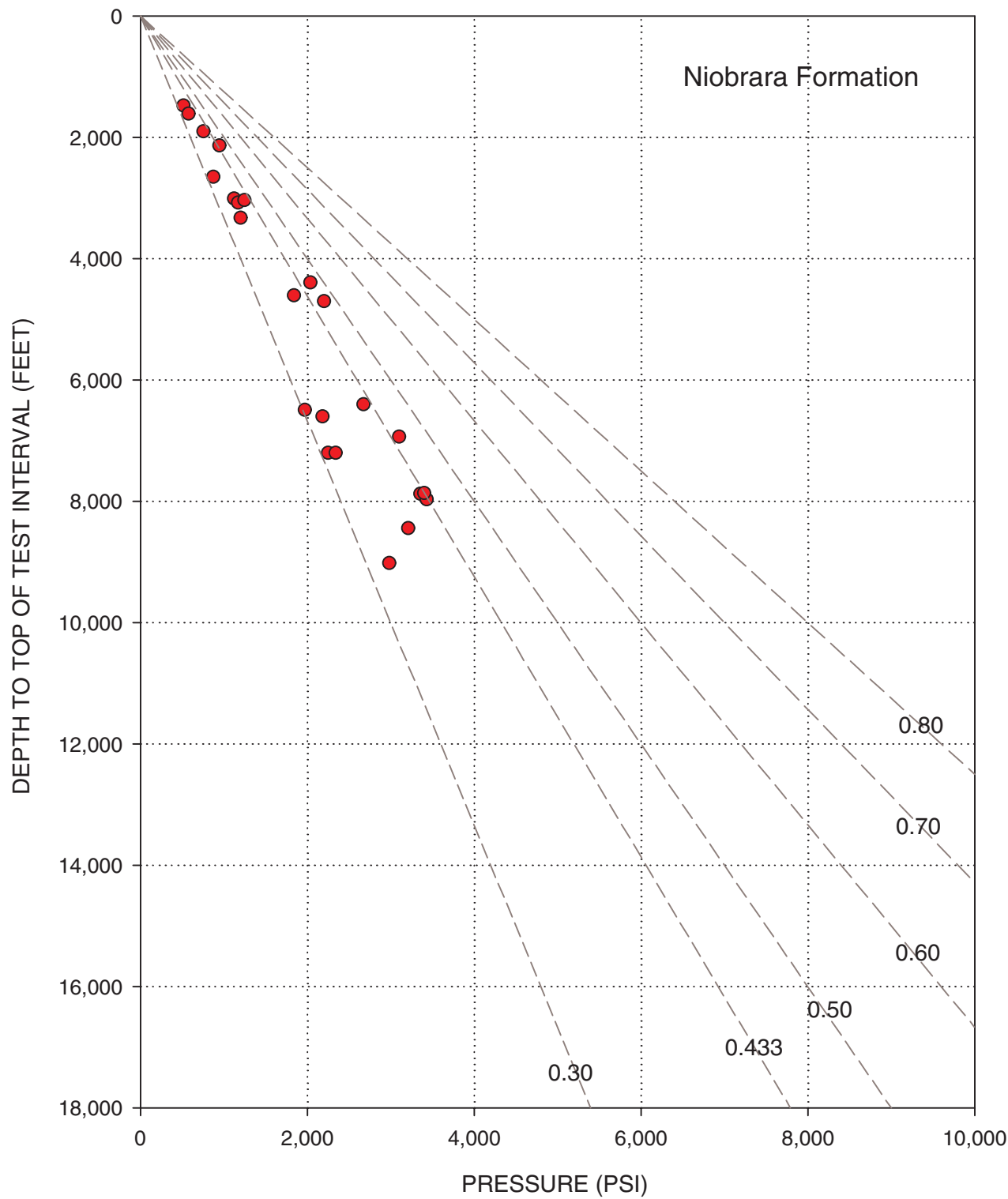
**Figure 3F.** Maximum gas-flow rate (initial potential or production tests) in thousands of cubic feet per day (MCFD) and depth to top of tested interval in Cretaceous Frontier, Mowry, and Dakota Formations and age-equivalent formations in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 3D.



**Figure 4A.** Maximum pressure gradient in pounds per square inch per foot (psi/ft) from drill-stem tests in the Upper Cretaceous Niobrara Formation, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.



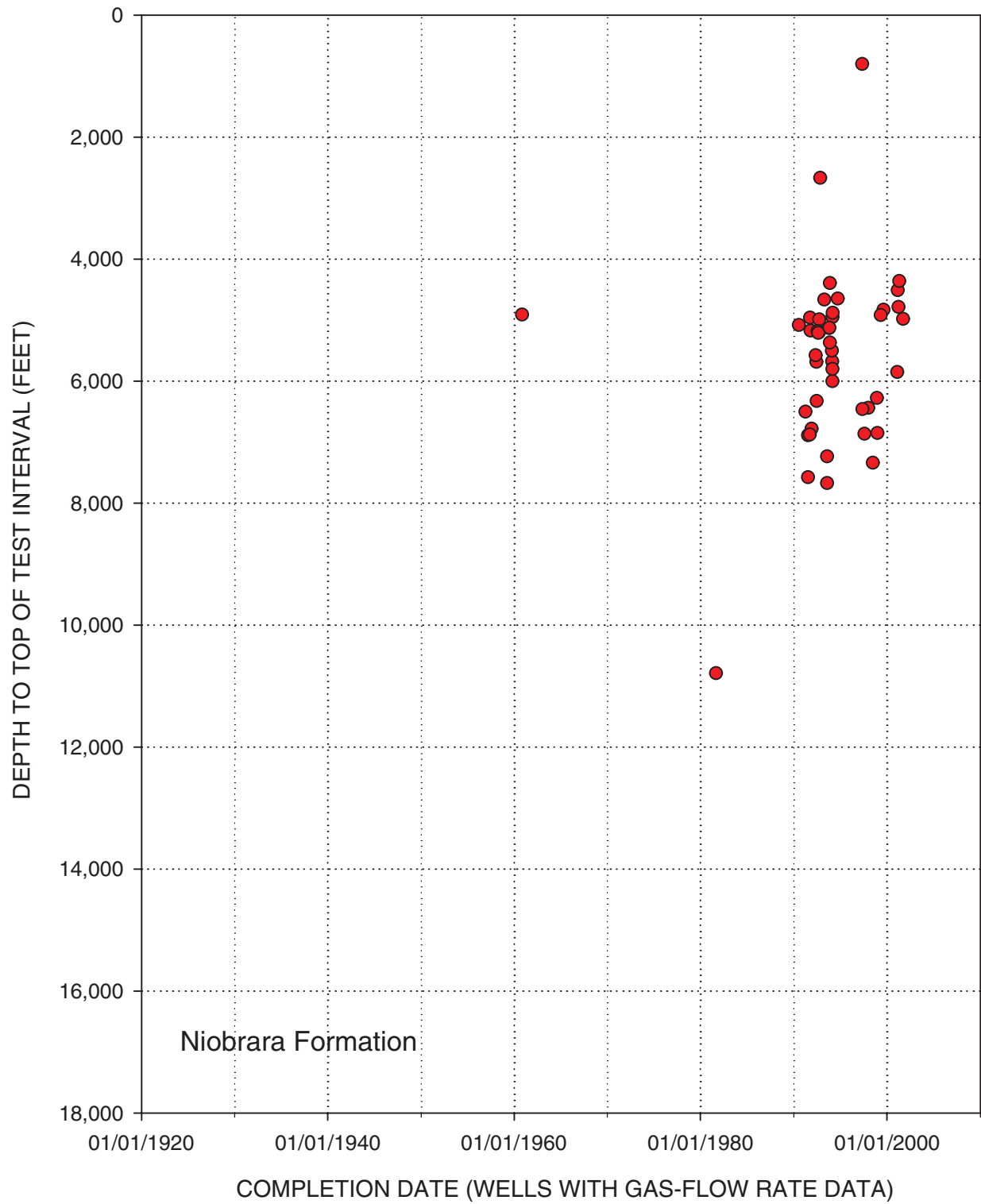
**Figure 4B.** Completion date and depth to tested intervals in wells with pressure data from Upper Cretaceous Niobrara Formation in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 4A.



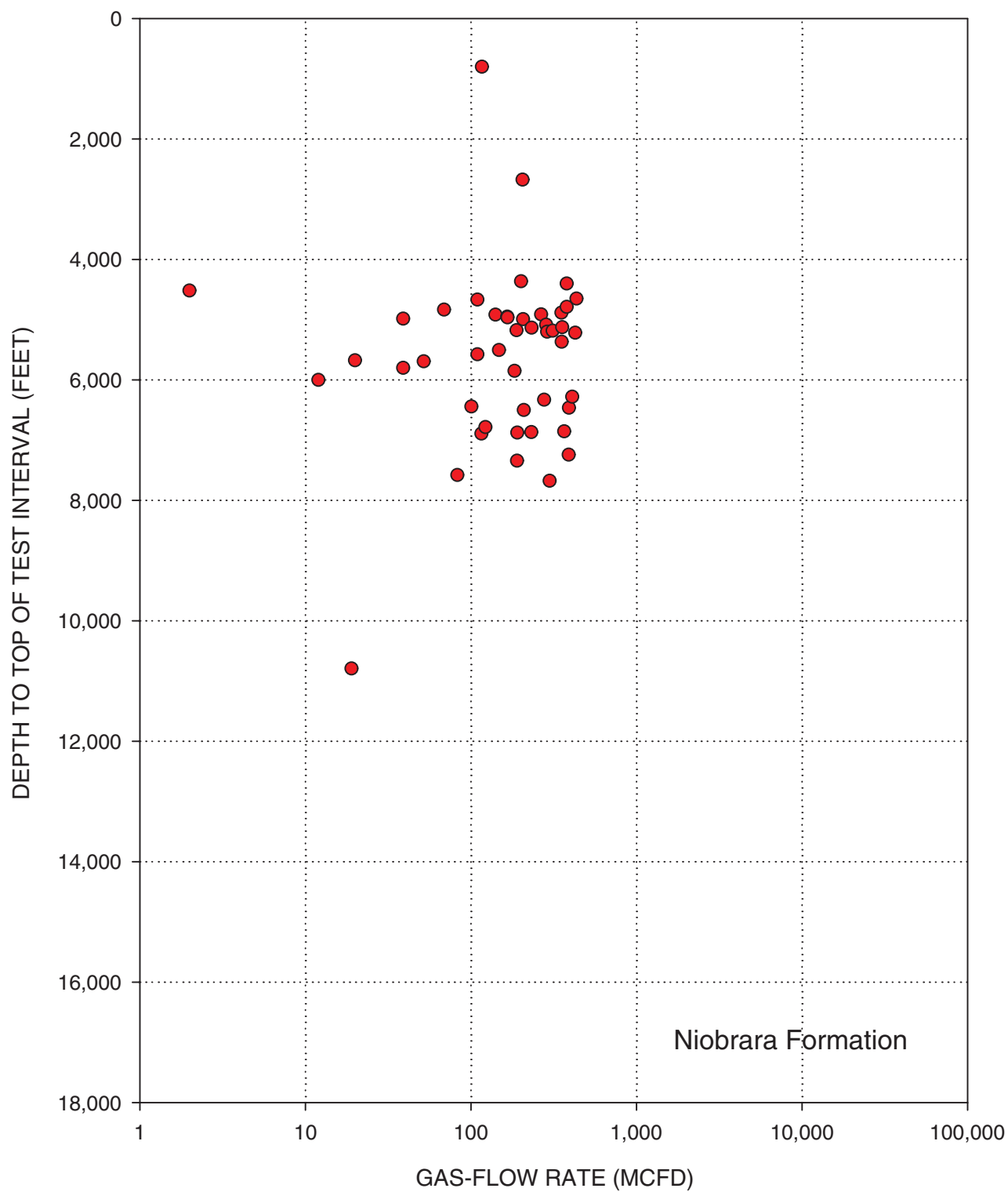
**Figure 4C.** Pressure data from wells with drill-stem tests in the Upper Cretaceous Niobrara Formation in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Lines of constant pressure gradient give ratio of pressure to depth in pounds per square inch per foot (psi/ft). Well locations are shown in figure 4A.



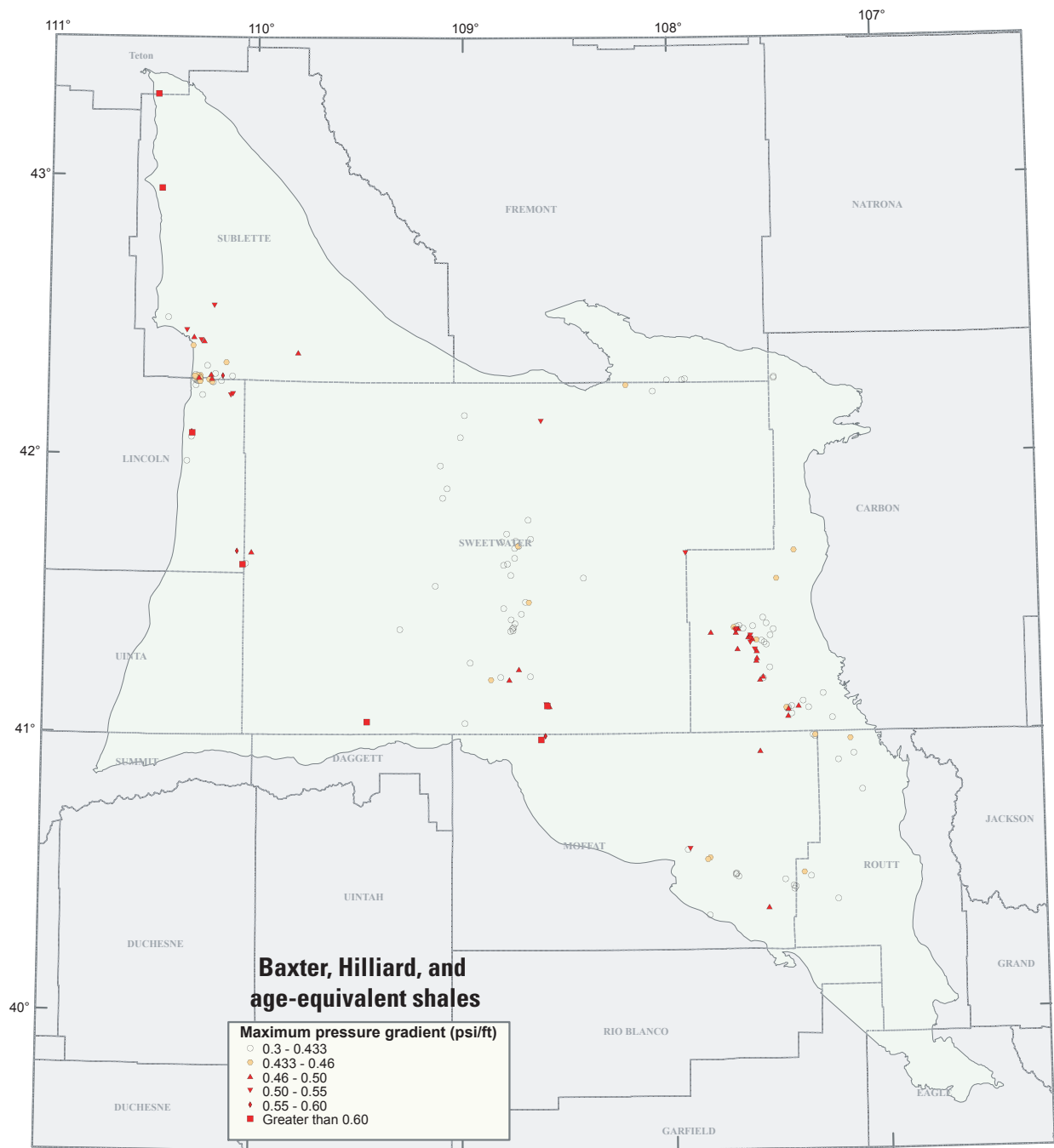
**Figure 4D.** Maximum gas-flow rates in thousands of cubic feet per day (MCFD) from well tests in the Upper Cretaceous Niobrara Formation, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.



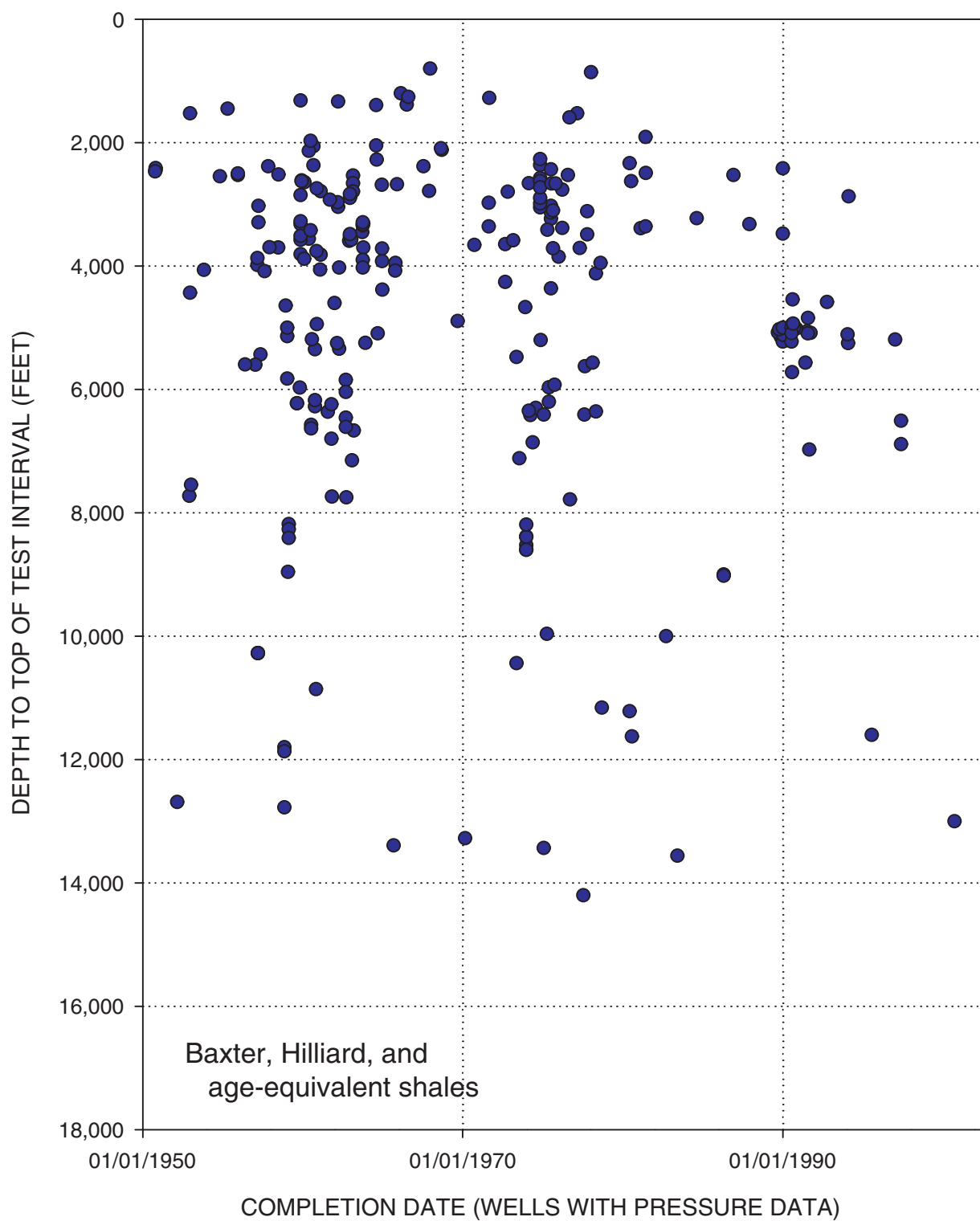
**Figure 4E.** Completion date and depth to tested intervals in wells with gas-flow rate data (initial potential or production tests) from the Upper Cretaceous Niobrara Formation in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 4D.



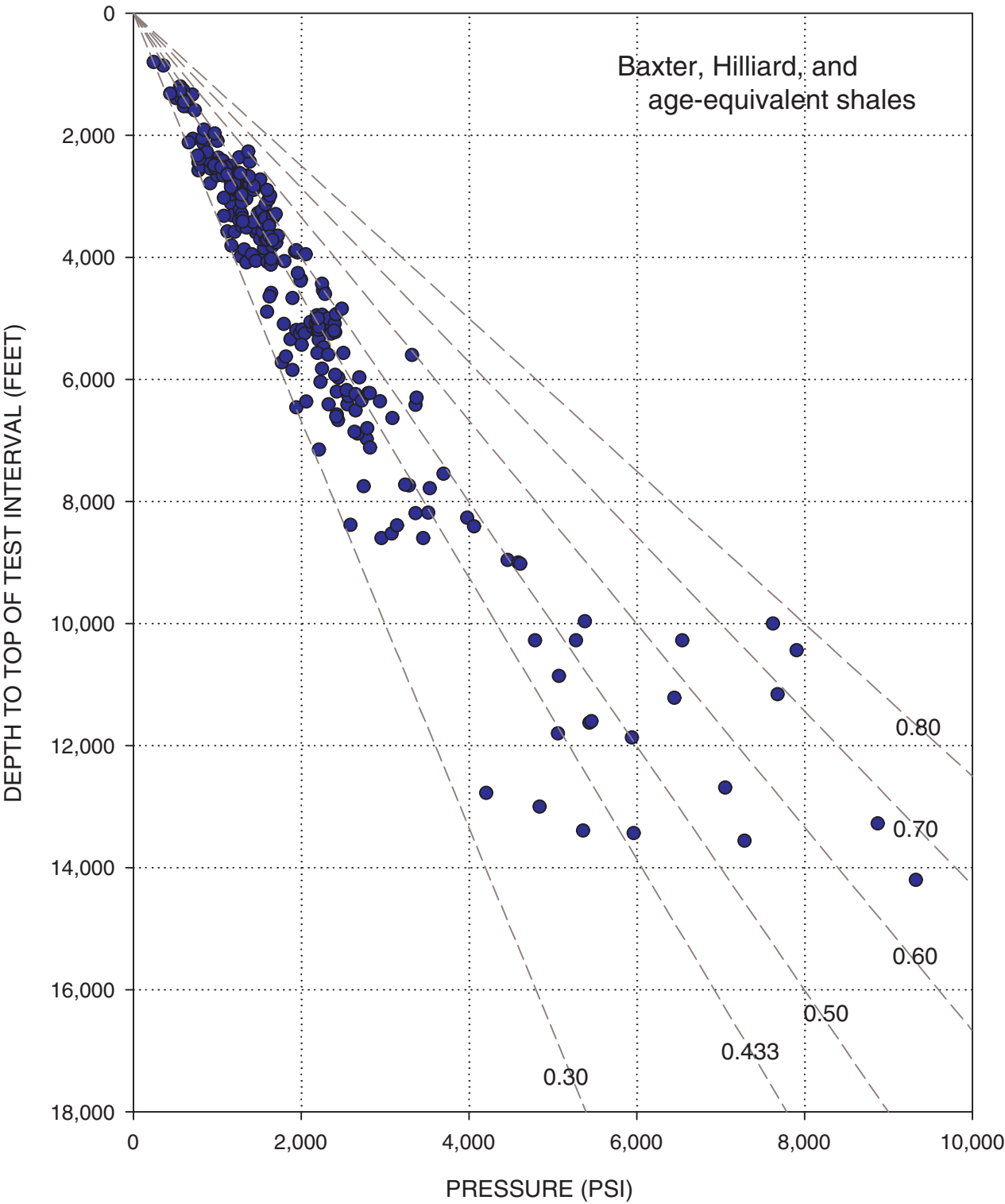




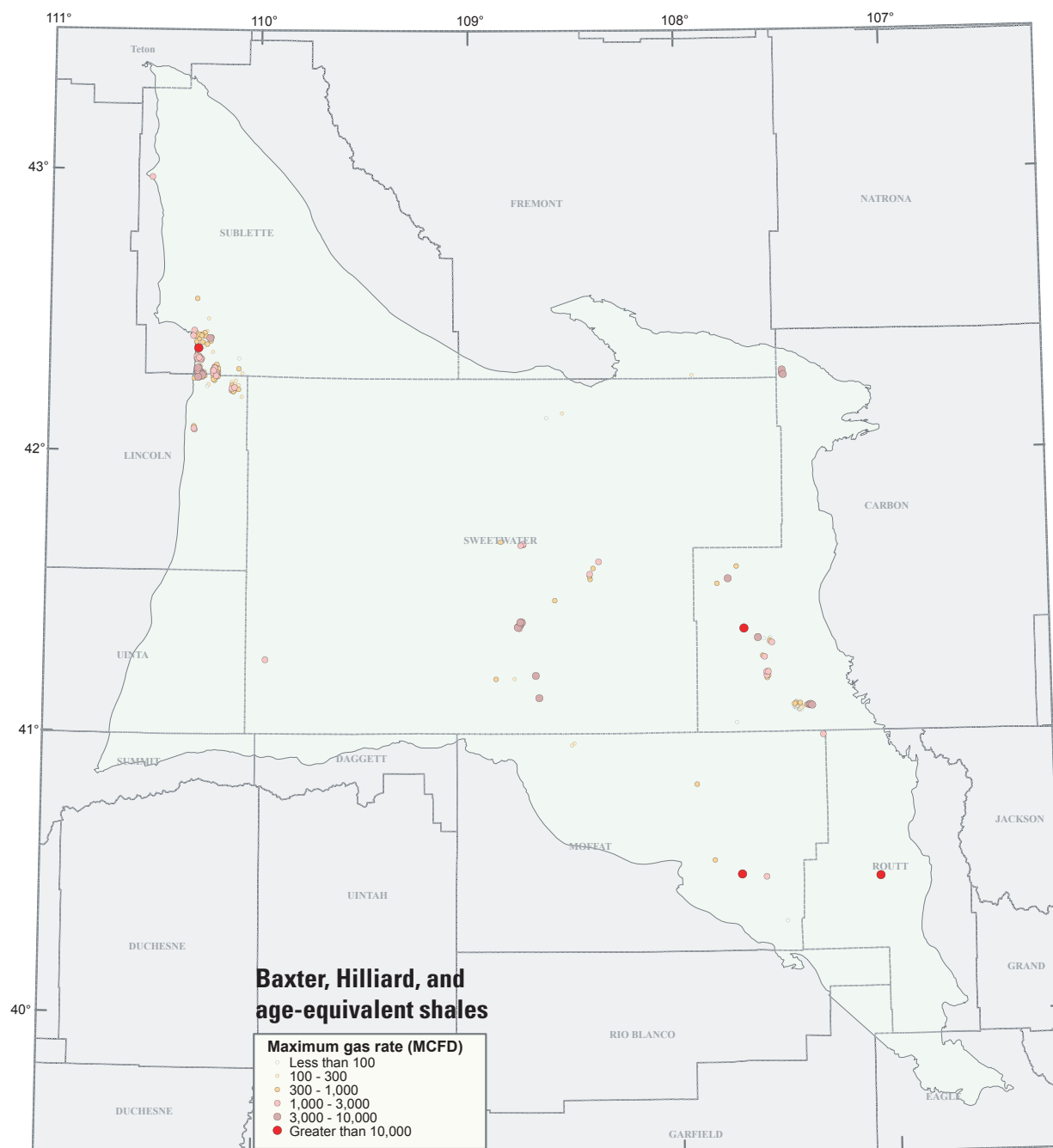
**Figure 5A.** Maximum pressure gradient in pounds per square inch per foot (psi/ft) from drill-stem tests in the Upper Cretaceous Baxter and Hilliard Shales and age-equivalent shales, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.



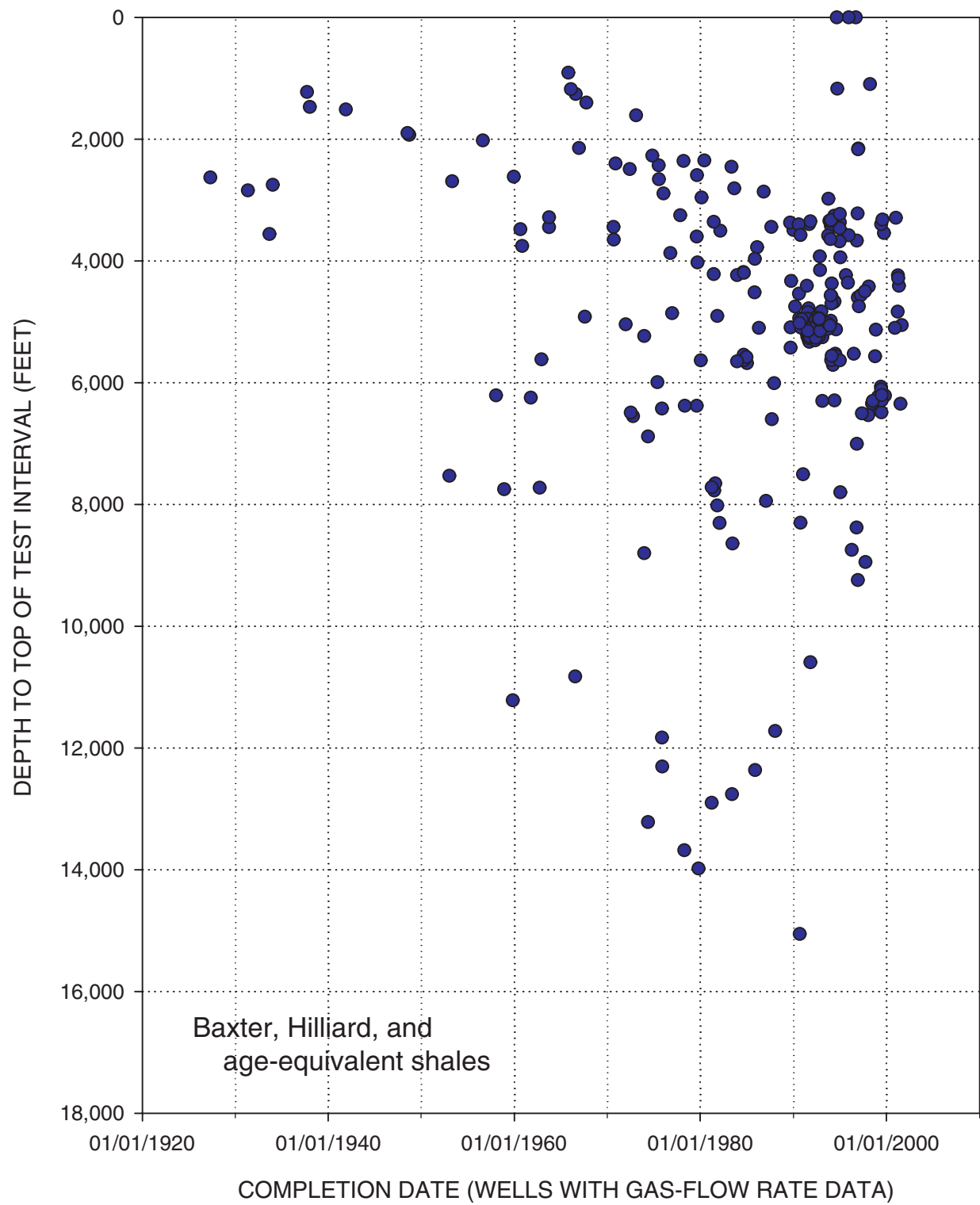
**Figure 5B.** Completion date and depth to tested intervals in wells with pressure data from Upper Cretaceous Baxter and Hilliard Shales and age-equivalent shales in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 5A.



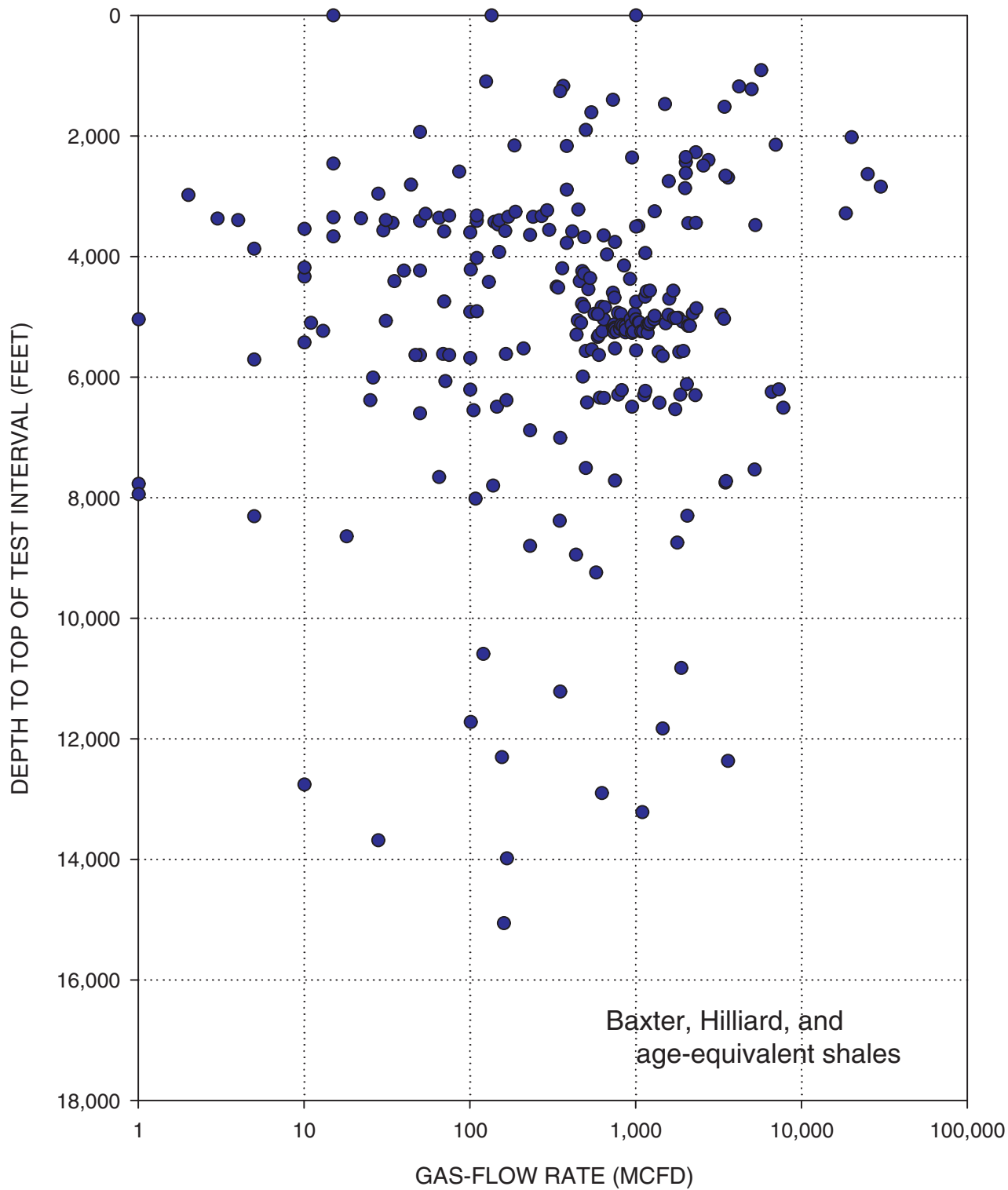
**Figure 5C.** Pressure data from wells with drill-stem tests in the Upper Cretaceous Baxter and Hilliard Shales and age-equivalent shales in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Lines of constant pressure gradient give ratio of pressure to depth in pounds per square inch per foot (psi/ft). Well locations are shown in figure 5A.



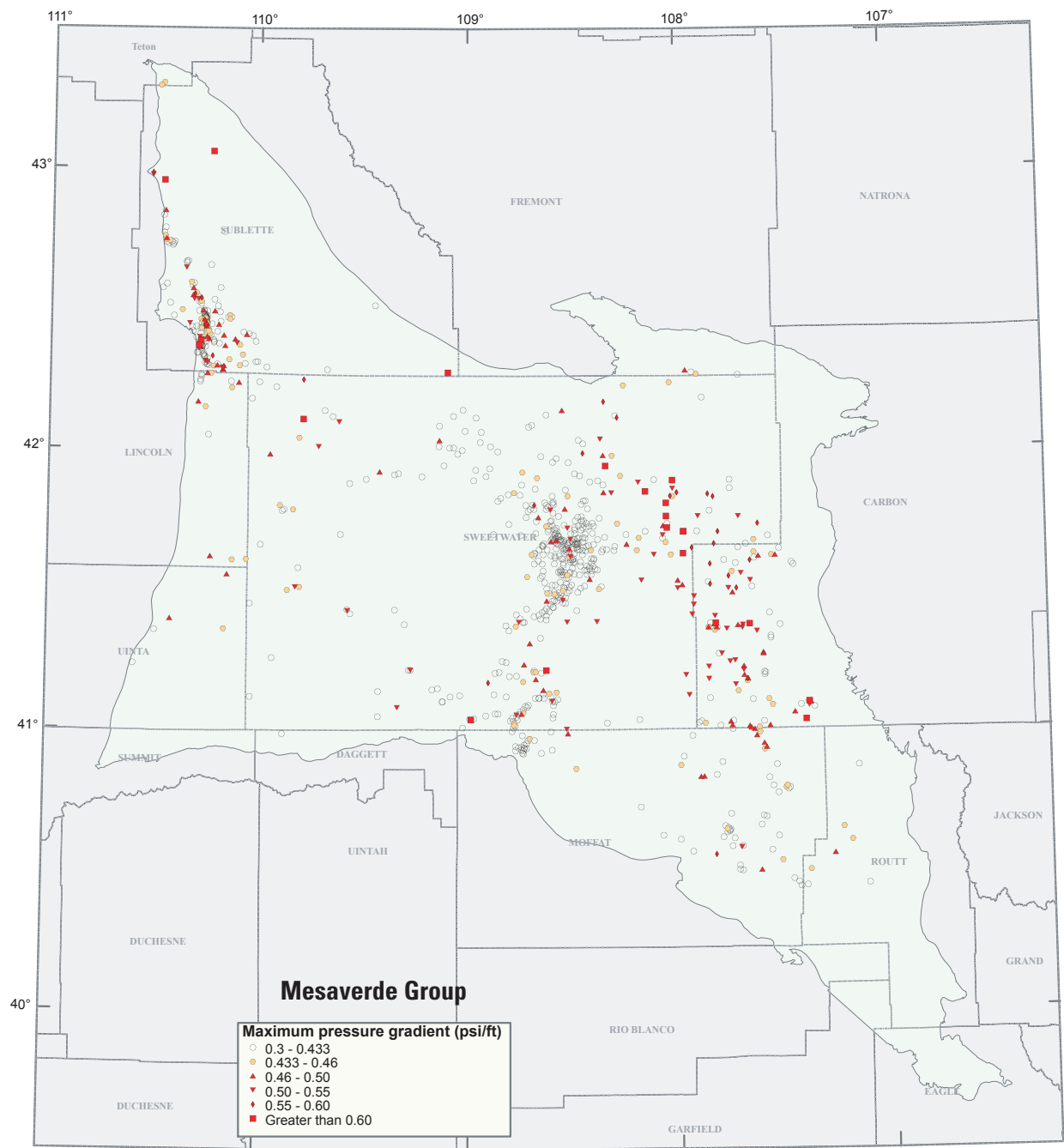
**Figure 5D.** Maximum gas-flow rates in thousands of cubic feet per day (MCFD) from well tests in the Upper Cretaceous Baxter, Hilliard and age-equivalent shales, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.



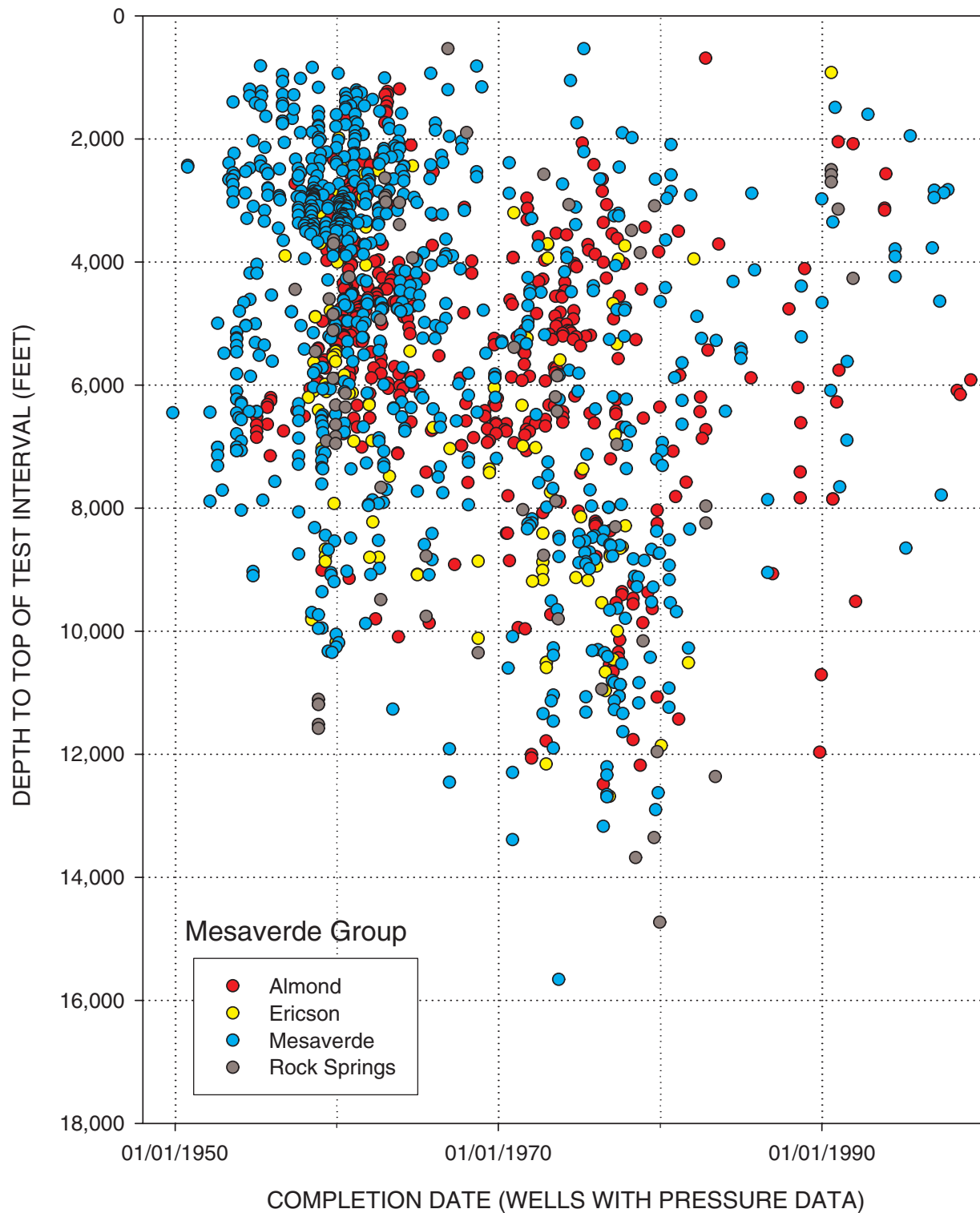
**Figure 5E.** Completion date and depth to tested intervals in wells with gas-flow rate data (initial potential or production tests) from the Upper Cretaceous Baxter and Hilliard Shales and age-equivalent shales in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 5D.



**Figure 5F.** Maximum gas-flow rate (initial potential or production tests) in thousands of cubic feet per day (MCFD) and depth to top of tested interval in the Upper Cretaceous Baxter and Hilliard Shales and age-equivalent shales in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 5D.

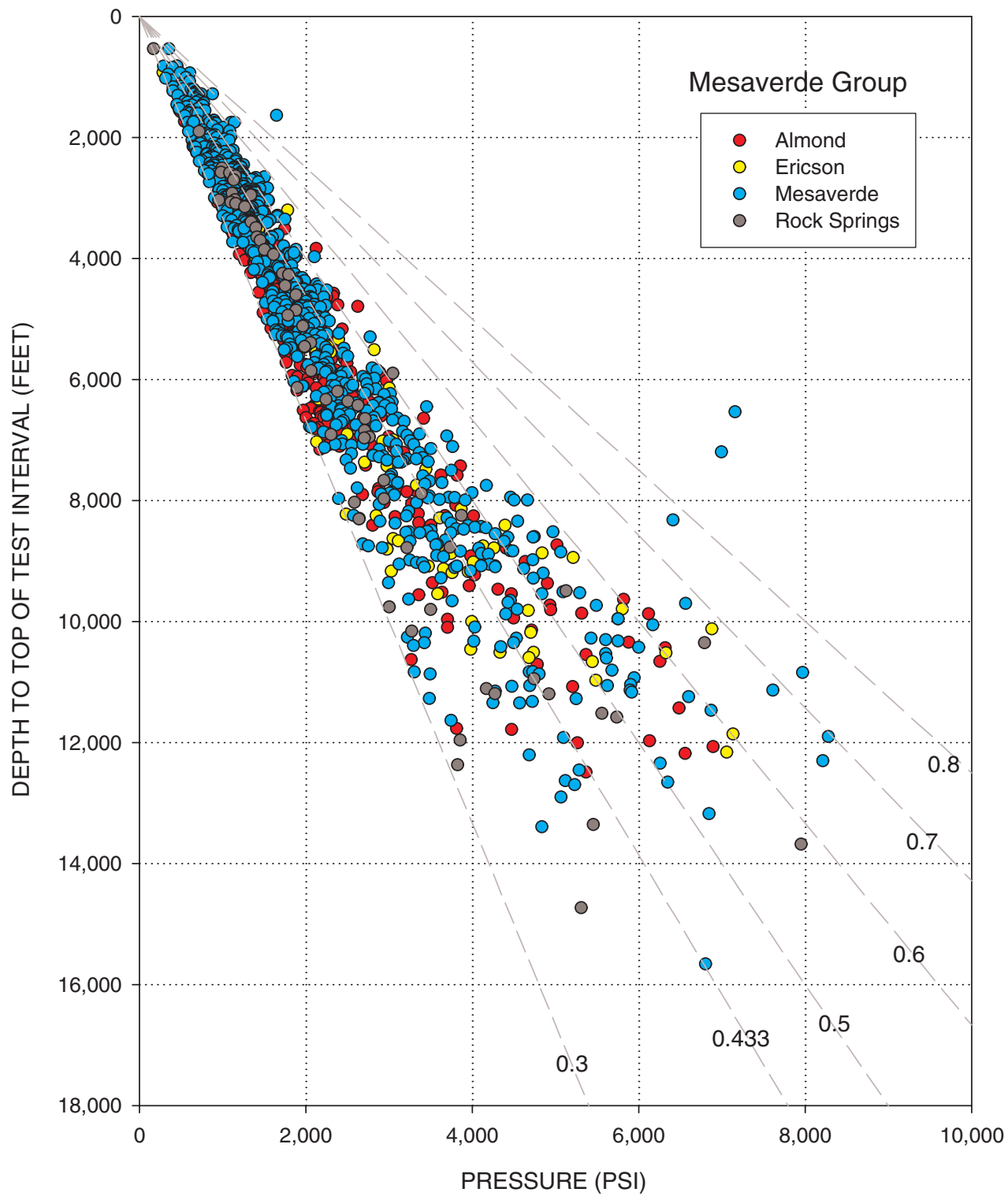


**Figure 6A.** Maximum pressure gradient in pounds per square inch per foot (psi/ft) from drill-stem tests in formations of the Upper Cretaceous Mesaverde Group, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.

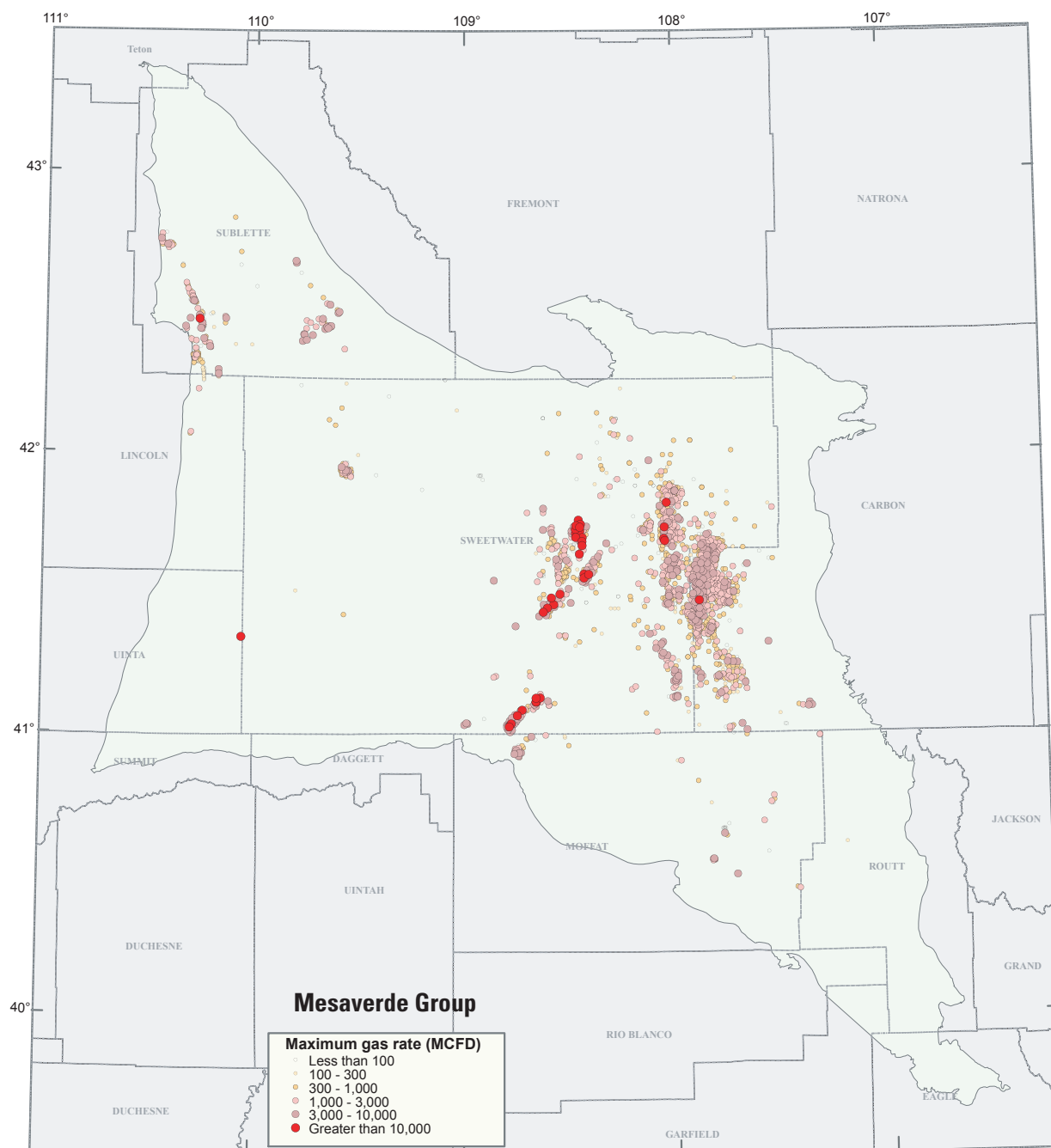


**Figure 6B.** Completion date and depth to tested intervals in wells with pressure data from the Upper Cretaceous Mesaverde Group in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 6A.

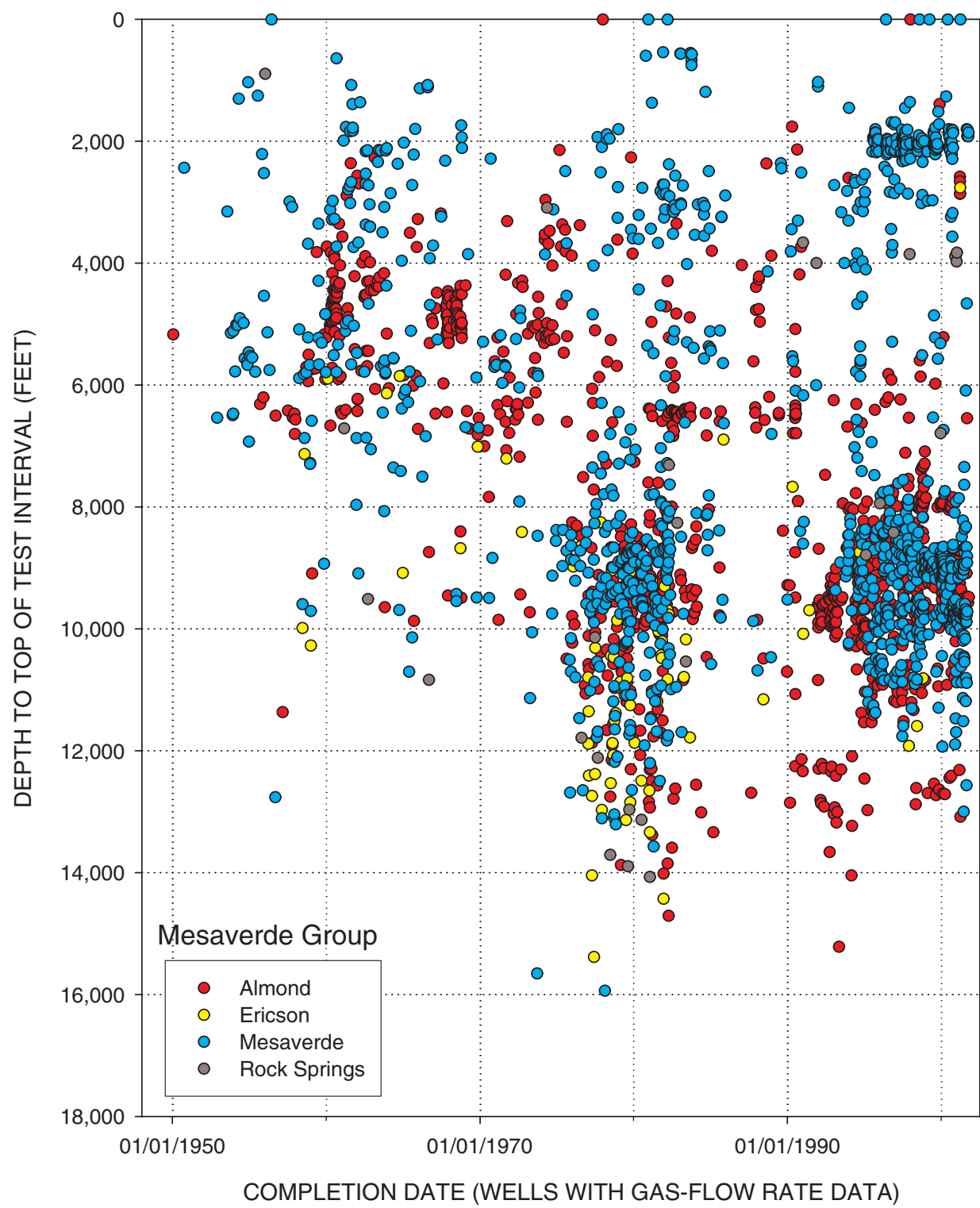




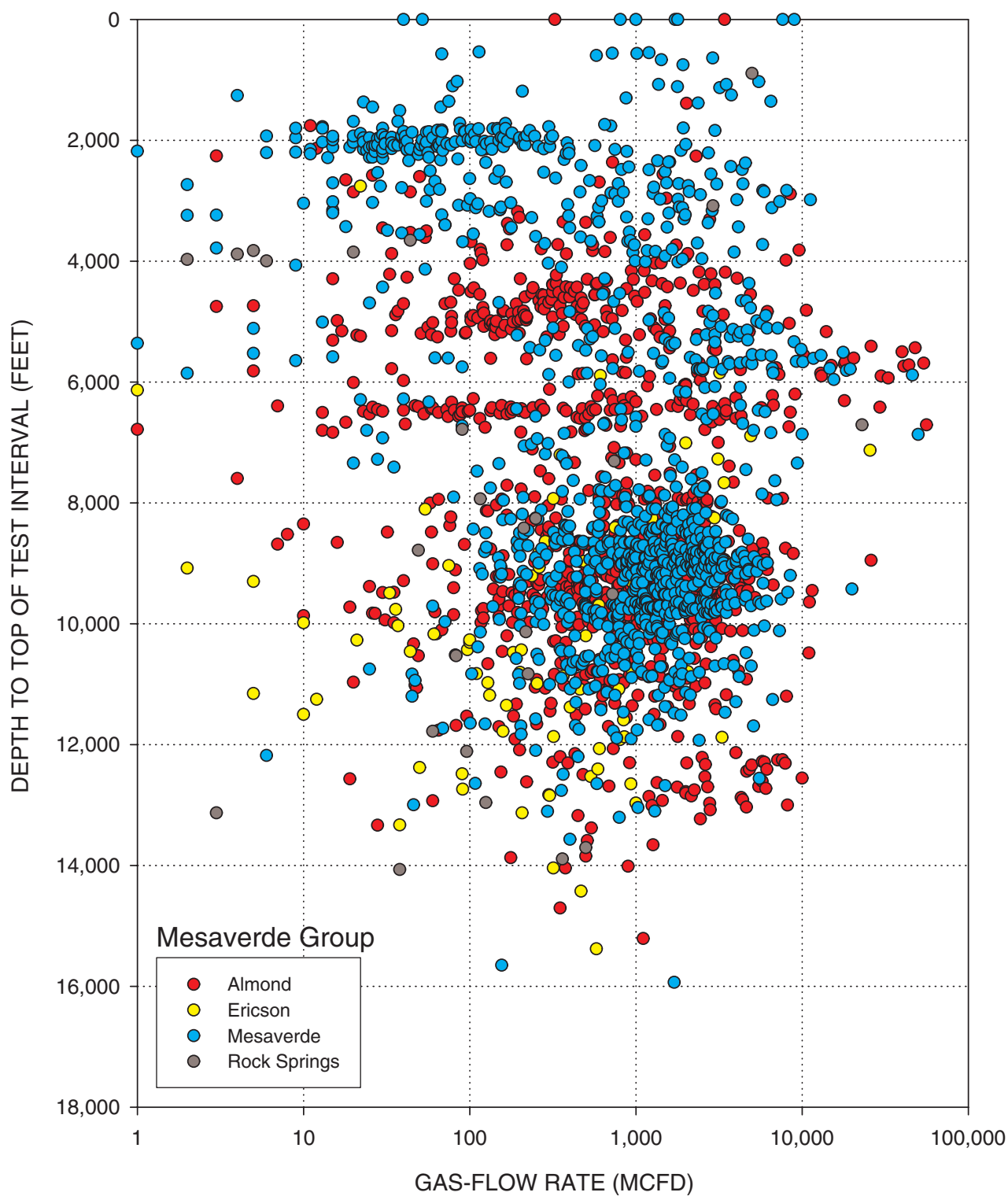
**Figure 6C.** Pressure data from wells with drill-stem tests in the Upper Cretaceous Mesaverde Group in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Lines of constant pressure gradient give ratio of pressure to depth in pounds per square inch per foot (psi/ft). Well locations are shown in figure 6A.



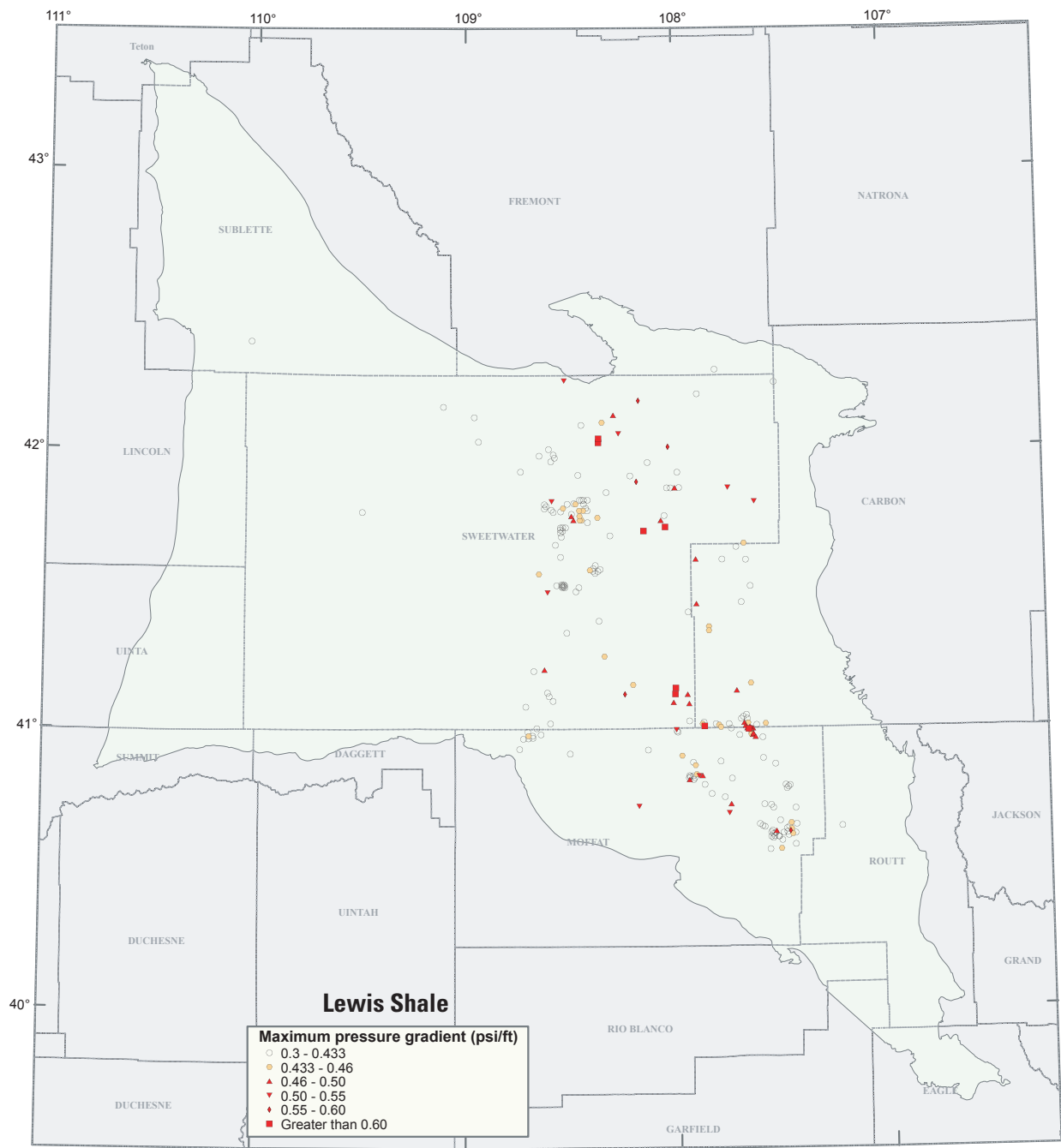
**Figure 6D.** Maximum gas-flow rates in thousands of cubic feet per day (MCFD) from well tests in formations of the Upper Cretaceous Mesaverde Group, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.



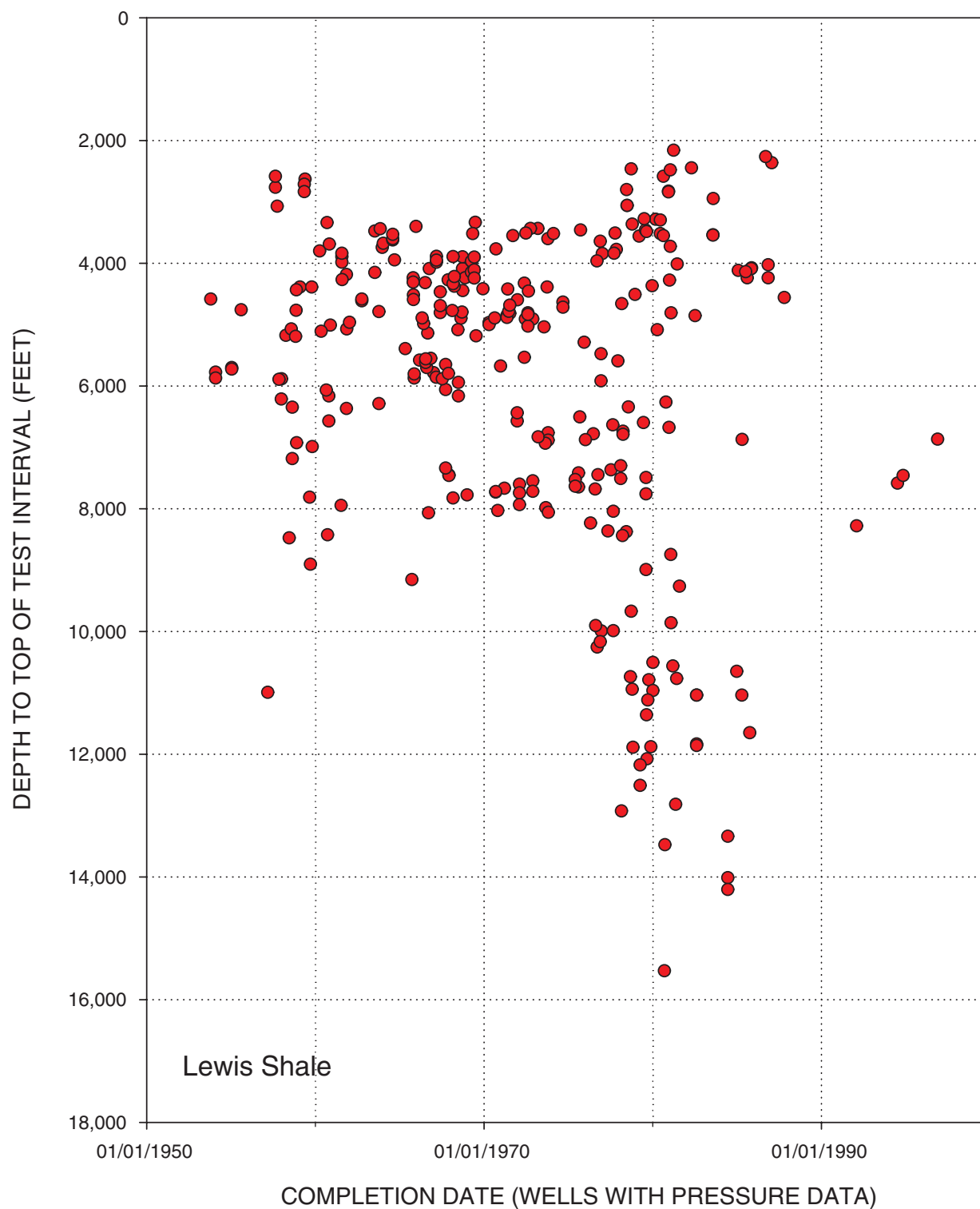
**Figure 6E.** Completion date and depth to tested intervals in wells with gas-flow rate data (initial potential or production tests) from the Upper Cretaceous Mesaverde Group in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 6D.



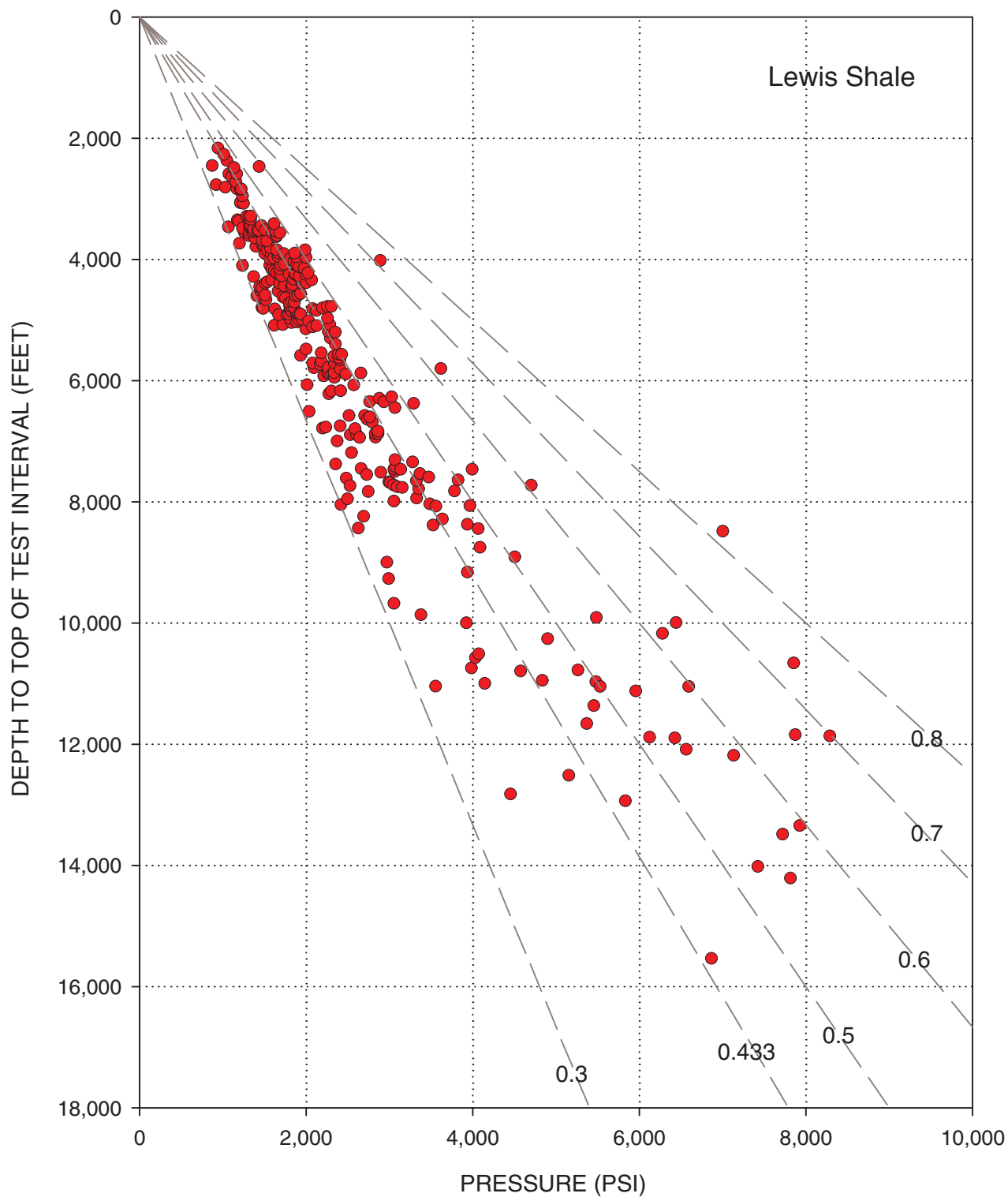
**Figure 6F.** Maximum gas-flow rate (initial potential or production tests) in thousands of cubic feet per day (MCFD) and depth to top of tested interval in the Upper Cretaceous Mesaverde Group in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 6D.



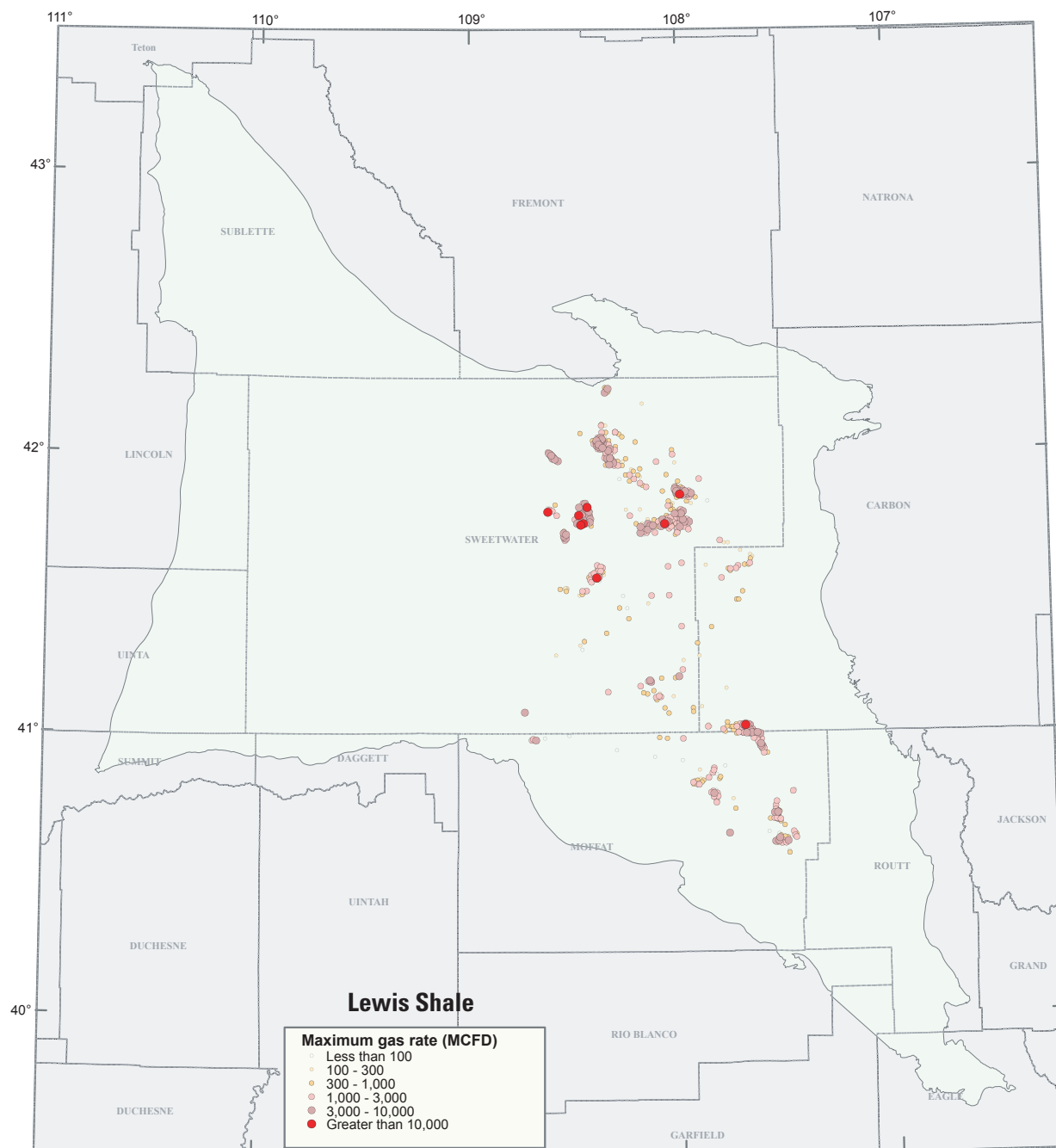
**Figure 7A.** Maximum pressure gradient in pounds per square inch per foot (psi/ft) from drill-stem tests in Upper Cretaceous Lewis Shale, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.



**Figure 7B.** Completion date and depth to tested intervals in wells with pressure data from the Upper Cretaceous Lewis Shale in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 7A.

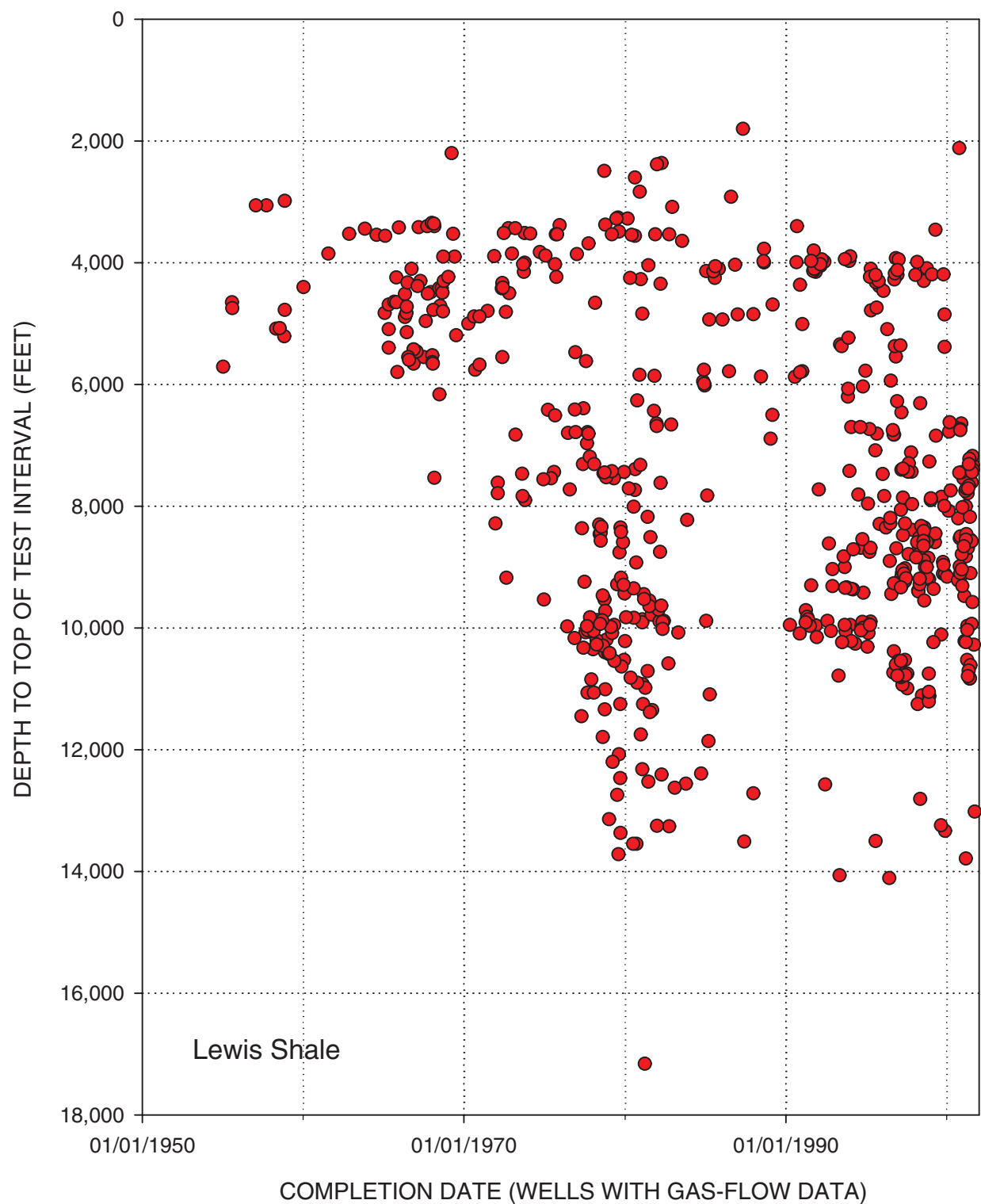


**Figure 7C.** Pressure data from wells with drill-stem tests in the Upper Cretaceous Lewis Shale in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Lines of constant pressure gradient give ratio of pressure to depth in pounds per square inch per foot (psi/ft). Well locations are shown in figure 7A.

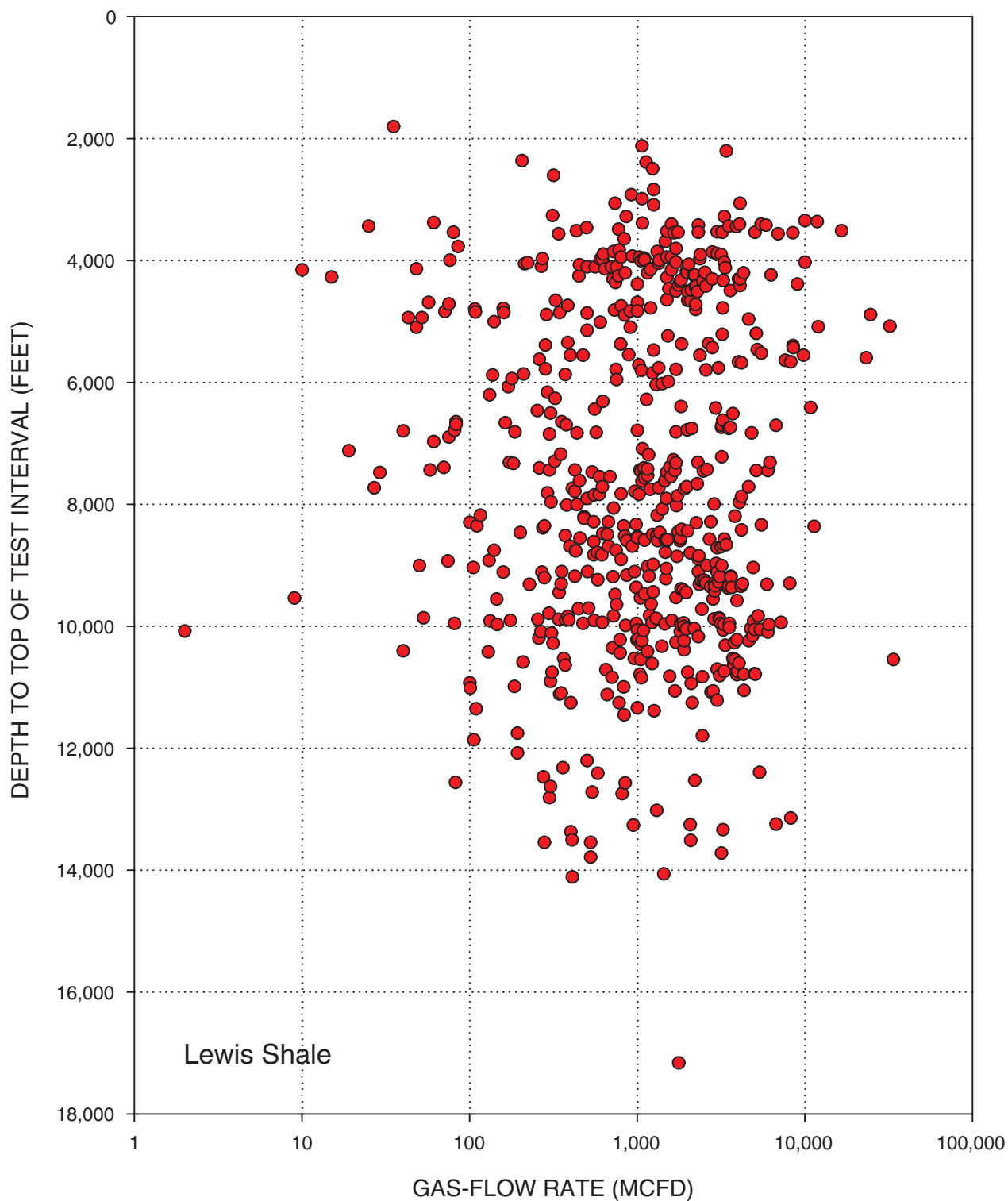


**Figure 7D.** Maximum gas-flow rates in thousands of cubic feet per day (MCFD) from well tests in the Upper Cretaceous Lewis Shale, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.

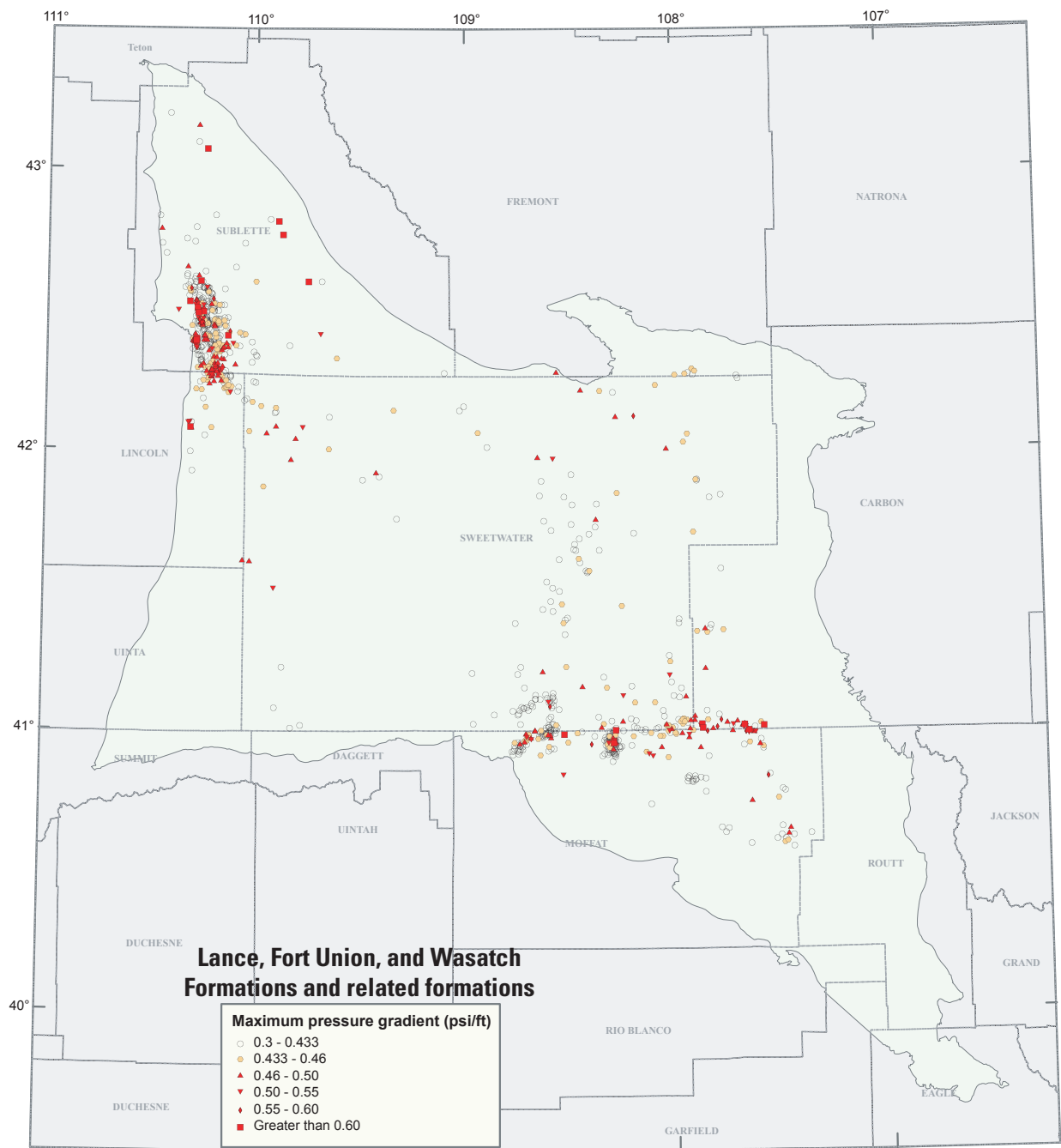




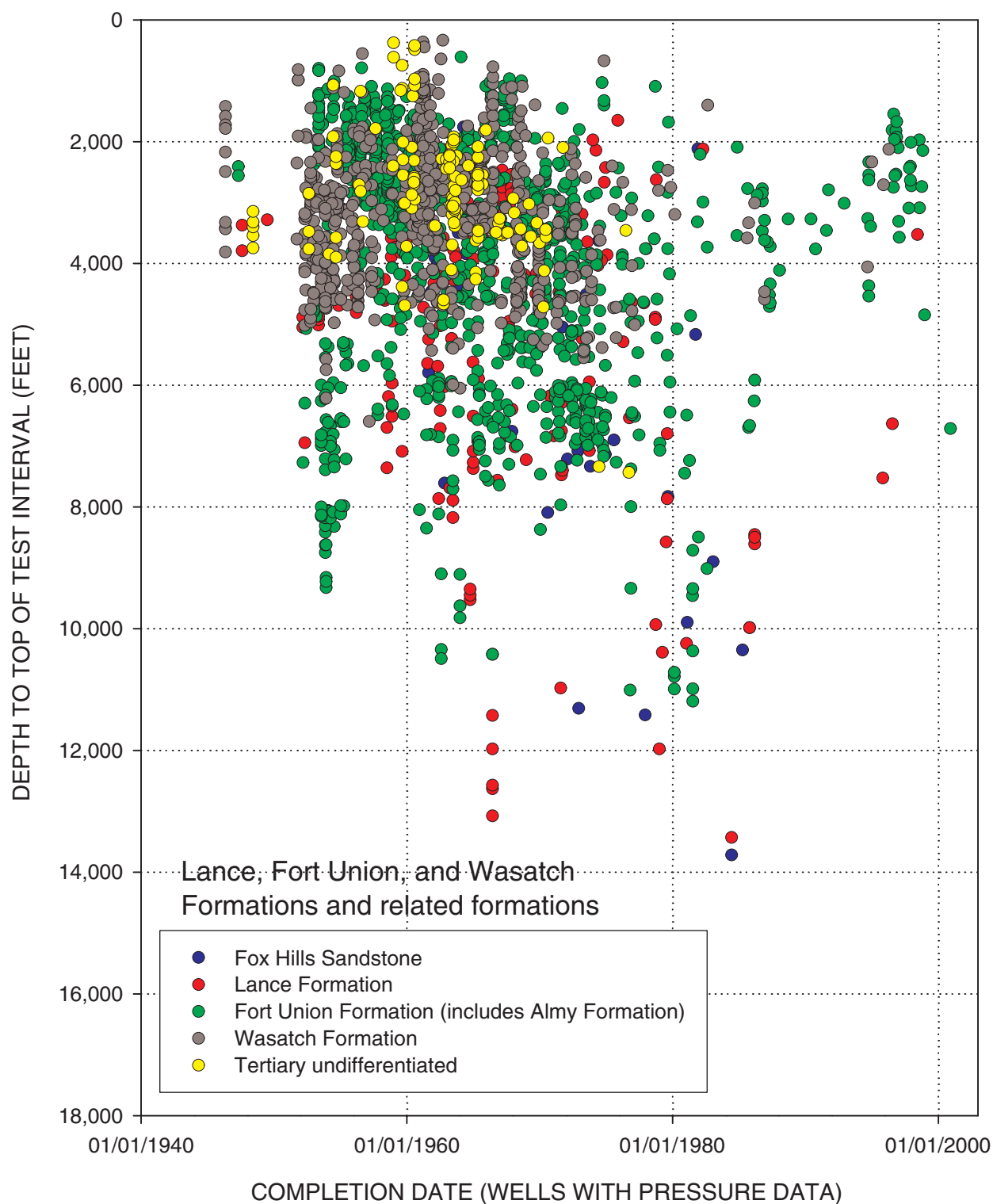
**Figure 7E.** Completion date and depth to tested intervals in wells with gas-flow rate data (initial potential or production tests) from the Upper Cretaceous Lewis Shale in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 7D.



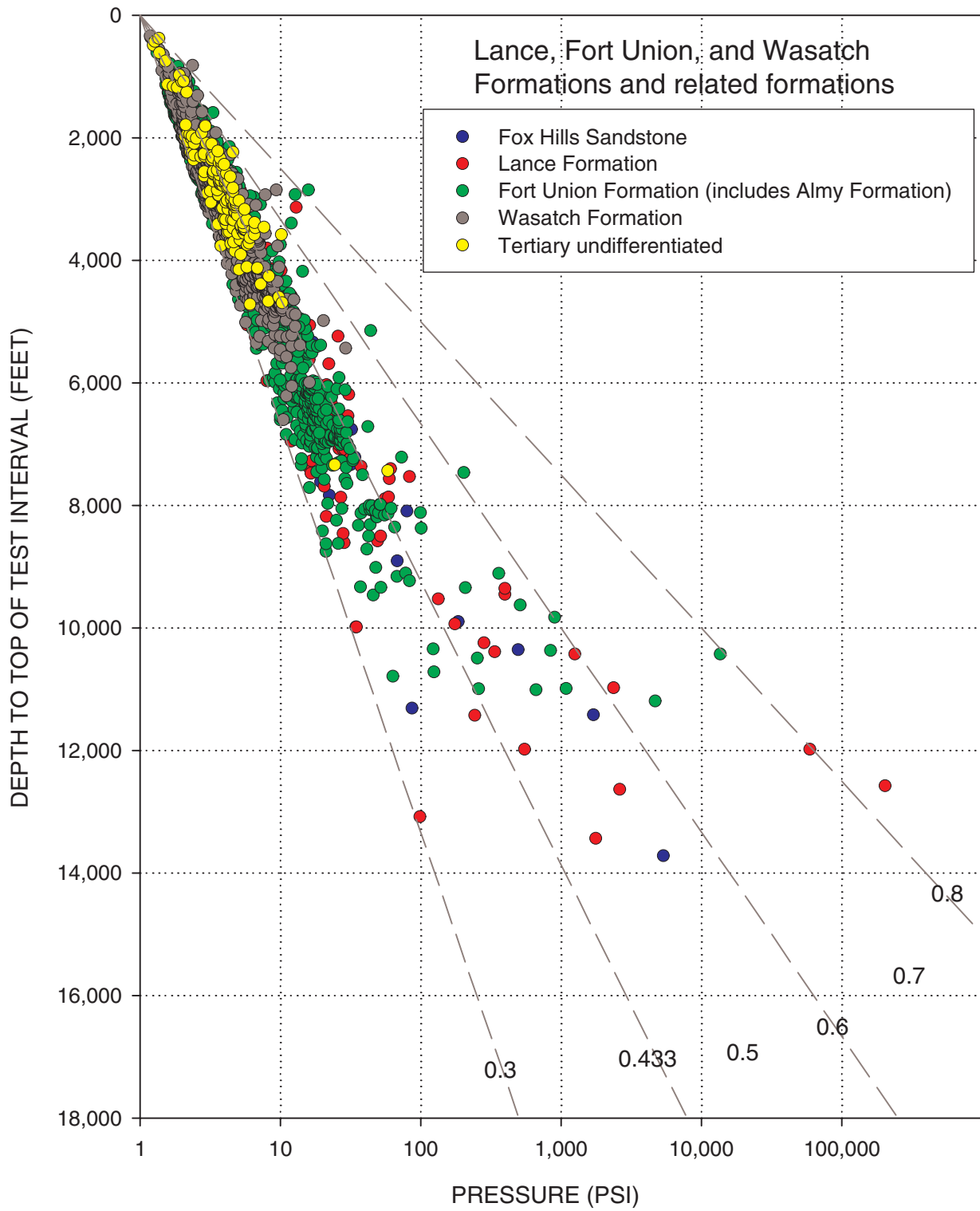
**Figure 7F.** Maximum gas-flow rate (initial potential or production tests) in thousands of cubic feet per day (MCFD) and depth to top of tested interval in the Upper Cretaceous Lewis Shale in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 7D.



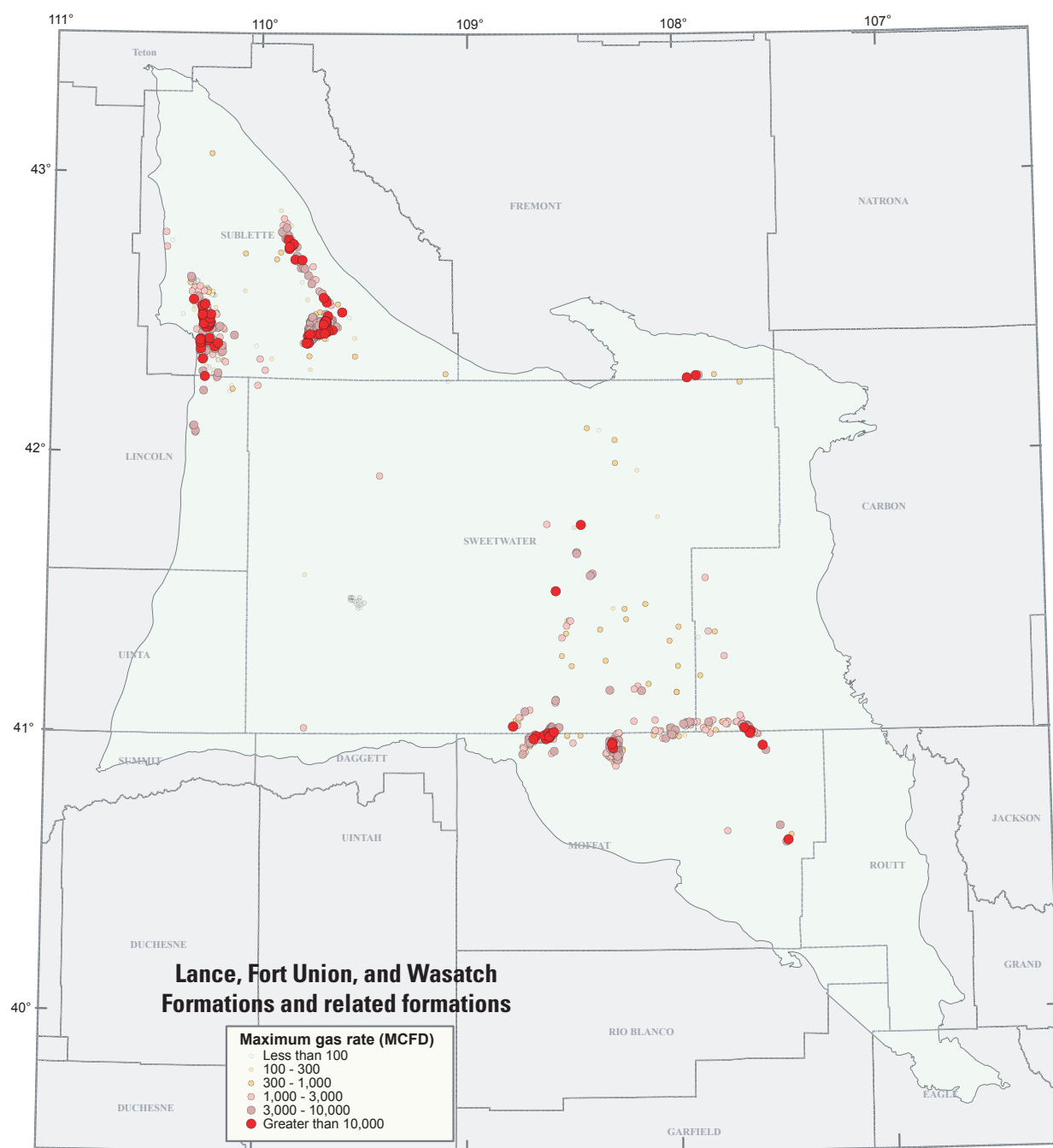
**Figure 8A.** Maximum pressure gradient in pounds per square inch per foot (psi/ft) from drill-stem tests in Upper Cretaceous and Tertiary Lance, Fort Union, and Wasatch Formations and related formations, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.



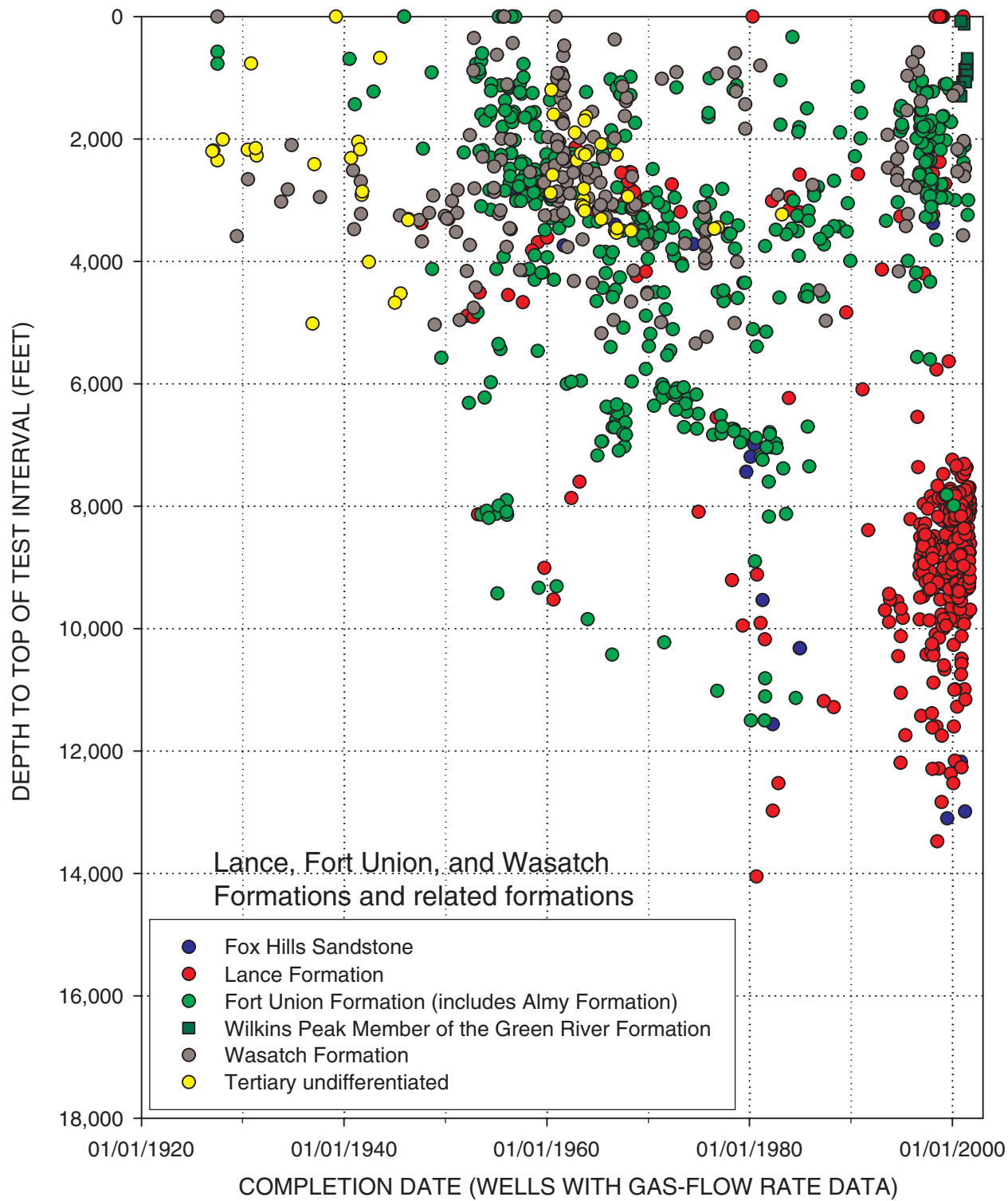
**Figure 8B.** Completion date and depth to tested intervals in wells with pressure data from the Upper Cretaceous and Tertiary Lance, Fort Union, and Wasatch Formations and related formations in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 8A.



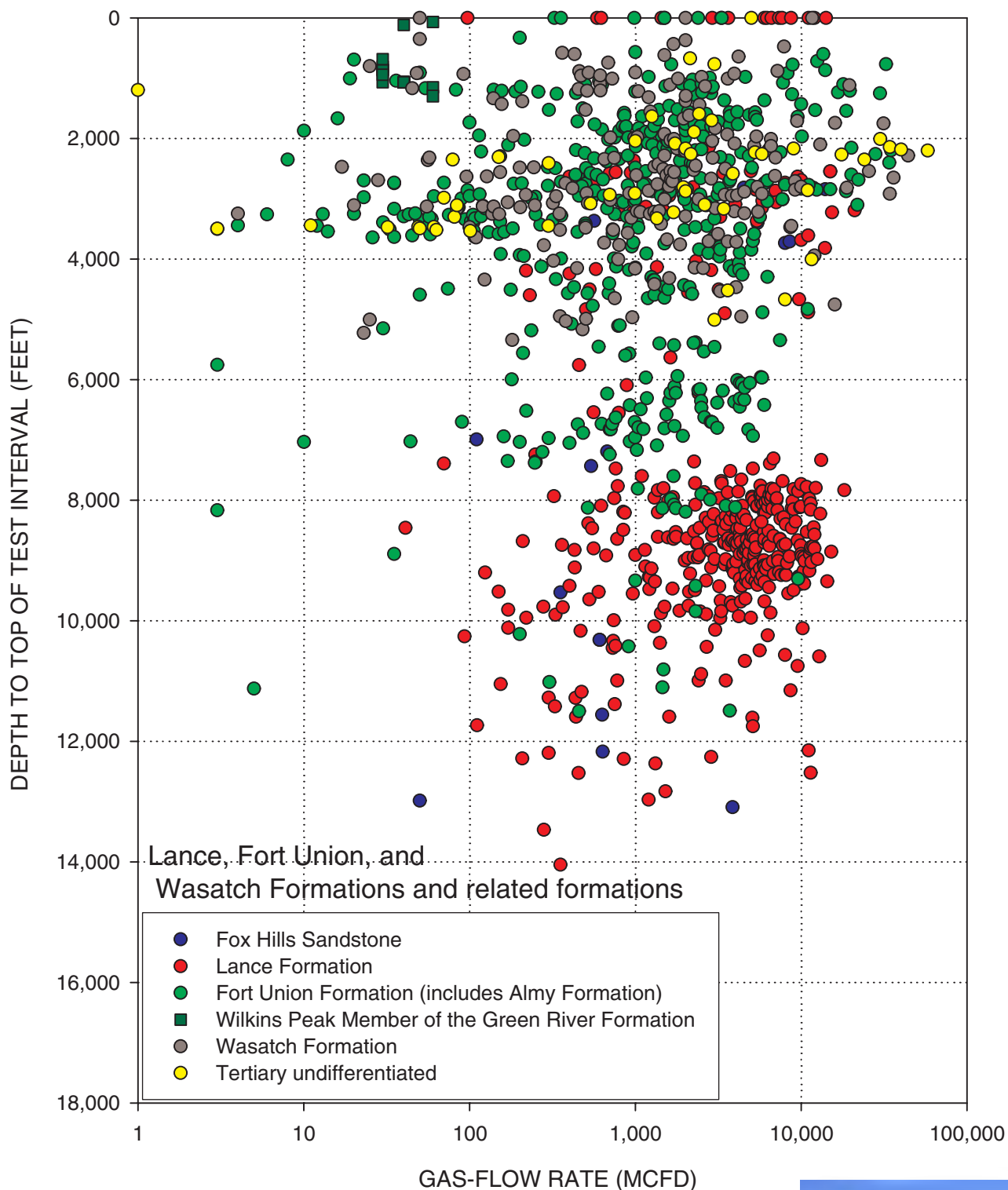
**Figure 8C.** Pressure data from wells with drill-stem tests in the Upper Cretaceous and Tertiary Lance, Fort Union, and Wasatch Formations, and related formations in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Lines of constant pressure gradient give ratio of pressure to depth in pounds per square inch per foot (psi/ft). Well locations are shown in figure 8A.



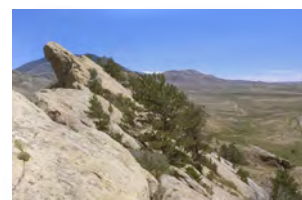
**Figure 8D.** Maximum gas-flow rates in thousands of cubic feet per day (MCFD) from well tests in Upper Cretaceous and Tertiary Lance, Fort Union, and Wasatch Formations and related formations, Southwestern Wyoming Province, Wyoming, Colorado, and Utah.



**Figure 8E.** Completion date and depth to tested intervals in wells with gas-flow-rate data (initial potential or production tests) from the Upper Cretaceous and Tertiary Lance, Fort Union, and Wasatch Formations and related formations in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 8D.



**Figure 8F.** Maximum gas-flow rate (initial potential or production tests) in thousands of cubic feet per day (MCFD) and depth to top of tested interval in the Upper Cretaceous and Tertiary Lance, Fort Union, and Wasatch Formations and related formations in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah. Well locations are shown in figure 8D.



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